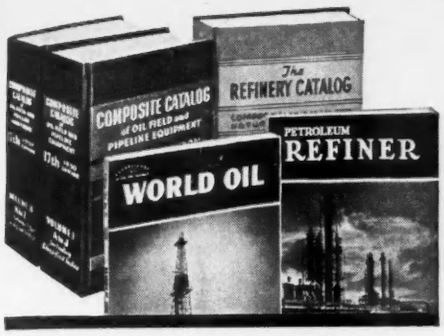


Specialized Oil Publications of
THE GULF PUBLISHING COMPANY
3301 Buffalo Drive, Houston 6, Texas
Box 2608, Houston 1, Texas

WORLD OIL and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

PETROLEUM REFINER and The REFINERY CATALOG
for the refining-natural gasoline industry

RAY L. DUDLEY, *President, Publisher*
A. L. BURNS, *General Manager*
WARREN L. BAKER, *Editorial Director*

EDITORIAL STAFF

WARREN L. BAKER, *Editor*
AL REESE, *Managing Editor*
L. J. LOGAN, *Associate Editor*
ELTON STERRETT, *Engineering Editor*
CECIL W. SMITH, *Statistical Editor*
MARK OLSON, *International Editor*

DISTRICT EDITORS

J. E. KASTROP, 3301 Buffalo Drive, Houston 6, Texas
ROBERT E. SPANN, 250 Park Ave., New York 17, N. Y.
GILBERT M. WILSON, W. W. Wilson Bldg., Huntington Park, Calif.
ANTHONY GIBBON, Hunt Bldg., Tulsa 3, Okla.
MARION DENNARD SYLVIA LILLIE
RUTH THOMPSON
Editorial Assistants
MARY A. ZUBER, *Librarian*

ADVERTISING STAFF

TOM W. NELSON, *Advertising Manager*
ROGER MOTHERAL, *Eastern Advertising Manager*
250 Park Ave., New York 17, N. Y.
NELSON BIGELOW, 250 Park Ave., New York 17, N. Y.
BILL WESTFALL, 1010 Euclid Ave., Cleveland 15, Ohio
H. G. FITZPATRICK, 332 S. Michigan Ave., Chicago 4, Ill.
BILL ATCHESON, Hunt Bldg., Tulsa 3, Okla.
J. W. CURTS, W. W. Wilson Bldg., Huntington Park, Calif.
CHARLES WYATT, 3301 Buffalo Drive,
DOUG CRAIG, 3301 Buffalo Drive
Houston 6, Texas

CIRCULATION DEPARTMENT

R. M. DE SOMBRE, *Manager*

Single copies 50 cents (except special issues). Subscription price: domestic and foreign, $2 a year; 2 years, $3; 3 years, $4. WORLD OIL, published every month except semi-monthly in February and July. Entered as *The Oil Weekly* as second class mail matter December 23, 1916, at the post office at Houston, Texas, under the act of March 3, 1879. Advertising rates on application. Copyright, 1951, by The Gulf Publishing Company.

Indexed by Industrial Arts Index and Engineering Index

To All Oil Men . . .

The April WORLD OIL will be our annual Exploration Issue. In it you'll find detailed data on geophysical activity, latest developments in geophysics, cost breakdowns and many other timely items. Start a personal subscription with this issue.

ABC WORLD OIL HSP
Established 1916 as THE OIL WEEKLY

CONTENTS

March, 1951 **Vol. 132, No. 4**

CURRENT OUTLOOK SECTION

Looking Ahead ... 19
Editor's Page ... *Warren L. Baker* 21
The Changing Panorama ... 23
Report from the Observatory ... *Ray L. Dudley and Warren L. Baker* 24
Petroleum Trends ... *Cecil W. Smith* 26
Monthly News Analysis ... 28
Price-Wage Controls Cut Production ... *L. J. Logan* 32
The Month's Completions ... 34
The Rancher's Side ... 39
Better Bosses—The Humble Way ... *Al Reese* 44
Factors Involved in Forming Spacing Units ... *C. B. Caruthers* 48

EXPLORATION SECTION

Weathering and Other Surface Shooting Problems ... *Neal Clayton* 57
Clay Mineralogy and the Petroleum Industry ... *Ralph E. Grim* 61
Sedimentary Basins and Oil Occurrence ... *L. G. Weeks* 71
Exploration Makes Fast Start ... 76

DRILLING SECTION

Current Problems of the Drilling Contractor ... *A. W. Thompson* 83
WORLD OIL Graphics: Suction Hose Care ... 88
Operating Guide for A.C. Drilling Rig Motors ... *Louis J. Murphy* 89
Hazards in Outdated Drilling Equipment Costs ... *F. W. Brigance* 98
Horizontal Centrifuge Desands Contaminated Mud ... *Anthony Gibbon* 99
Acidizing Practices in Canyon Reef Section, Scurry County ... *G. D. Simon* 100
Buckling of Rotary Drilling Strings (First of a Series) ... *Arthur Lubinski* 105
How to Do It—Drilling Hints ... 118

PRODUCTION SECTION

Factors in Well-Servicing Costs ... *W. E. Best* 133
"Bradford Practices" in California Water-Flooding ... *W. H. Somerton* 135
Corrosion Mitigation in the North McCallum Field (First of Two Parts ... *C. C. Frye, W. L. Giezentanner and Fred M. Clement* 138
Hydrafrac and Acidizing for Processing Limestones ... *C. E. Clason* 144
Wettability in Oil Recovery ... *P. T. Kinney and R. F. Nielsen* 145
Maintenance of Water-Flood Meters ... *H. O. Proske* 156
Fracture Spacing in Recovery of Repressured Oil ... *F. R. Cozzens* 159
How to Do It—Production Hints ... 165

PIPE LINE SECTION

Hydrocarbon Dewpoint Control by Gas Refrigeration ... *J. T. Simon* 175
Inspection of Pipe Coating ... *Marshall E. Parker* 178
Pipe Line Construction ... *Sylvia Lillie* 191
How to Do It—Pipe Line Hints ... 194

INTERNATIONAL SECTION

Kingdoms of Oil: Snyder, Texas (Second of a Series) ... *Mark Olson* 201
Aramco Contributes to Saudi Arabian Private Enterprise ... 207
Pakistan Activity Quickens ... 208
Reservoir Engineering: Leduc D-3 Zone Pool (Last of Three Parts) ... *James E. Baugh* 210
Of World Oil Men ... 217
Work Begins on Britain's Largest Oil Tanker Dock; Completion Set for 1952 218
Mexico's Coast-to-Coast Line to Be Ready in May ... 220
Maximum Restrictions Mean Minimum Oil, Says Suman ... 222

OTHER DEPARTMENTS

Advertisers' Index ... 2
Letters ... 14
The Oil Man's Calendar ... 32
New and Improved Equipment Supplementing Composite Catalog ... 226
Other New and Improved Equipment ... 236
New Literature ... 240
Men in the Industry News ... 242
Associations ... 254
Equipment and Service Suppliers' Notes ... 260
Trading Post (Classified Advertising) ... 266
New Books, Maps and Movies ... 267
Squeaks from the Bullwheel ... 268

ADVERTISERS' INDEX

* Asterisk preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current 17th (1950) edition of The Composite Catalog of Oil Field and Pipe Line Equipment.

A

*Acme Fishing Tool Co. 260
Aero Service Corp. 221
*Altens Foundry & Machine Works, Inc. 229
*American Iron & Machine Works Co. 91
American Chain & Cable Co. 183
*American Manufacturing Co. of Texas 4
*American Sand-Banum Co. 172
*Axelson Manufacturing Co. ..... 143 and 163

B

*B & W Incorporated 220
*Baash-Ross Tool Co. 113
*Baker Oil Tools, Inc. ..... 22 and 212-213
*Baroid Sales Division
National Lead Co. 271
Wm. M. Barret, Inc. 230
*Beaver Pipe Tools, Inc. 237
*Bethlehem Steel Co. ..... 51, 104 and 193
*Bethlehem Supply Co. 127
*Big Four Machine & Supply Co. 240
*Black, Sivalls & Bryson, Inc. 241
*The Brewster Co. 79
*Bucyrus-Erie Co. 235
Butler Manufacturing Co. 196

C

Cable & Stine 242
*Cameron Iron Works, Inc. 82
*Cardwell Manufacturing Co. 46-47
*Catawissa Valve & Fittings Co. 230
*Caterpillar Tractor Co. 29
*The Cavins Co. 237
Chicago & Southern Air Lines 216
*Chicago Pneumatic Tool Co. 63
*Chiksan Co. 258
*Christensen Diamond Products Co. 126
*Chrysler Corp. 190
The Dan L. Clark Drilling Co. 264
Climax Engine & Pump Mfg. Co. 10
*Construction Machinery Companies 234
*Fred E. Cooper, Inc. 253
Core Laboratories, Inc. 219
*Crane Co. 25
W. H. Curtin & Co. 222

D

*Darling Valve & Manufacturing Co. 224
*Detroit Diesel Engine Division
General Motors Corp. 251
*Diamond Chain Co. 60
Dowell Incorporated 20
*Dresser Industries, Inc. ..... 161 and 263
*Drilling & Service, Inc. 121
E. I. du Pont de Nemours & Co. 13

E

The Eagle-Picher Co. 259
*Eastman Oil Well Survey Co. 243
E. H. Edwards Co. 123
Empire Trust Co. 49
*Emsco Derrick & Equipment Co. 97
Equipment Identification Co. 268

F

*Fairbanks, Morse & Co. 167
The First National Bank & Trust Co. 247
*Fluid Packed Pump Co. 137
The Fluor Corp. 225

G

*Gaso Pump & Burner Manufacturing Co. 173
Manton Gaulin Manufacturing Co. 171
General Geophysical Co. 55
*General Motors Corp. 251
The Geolograph Co. 130
The B. F. Goodrich Co. 9
*H. P. Gott Manufacturing Co. 198
*Grant Oil Tool Co. 256
Great Lakes Carbon Corp. 129
*Grove Regulator Co. 189
*Gulf Coast Machine & Supply Co. 149

H

*Halliburton Oil Well Cementing Co. ..... I Cover
*Harbison-Fischer Manufacturing Co. 162
*Harrisburg Steel Corp. 262
*Hazard Wire Rope Division
American Chain & Cable Co. 183
*Hercules Tool Co. 170
*Hewitt-Robins, Inc. 239
*Hinderliter Tool Company Division
H. K. Porter Co. 272
Houston Contracting Co. 192
Houston Laboratories 230
*J. M. Huber Corp. 267
*Hughes Tool Co. ..... 199 and IV Cover
Humble Oil & Refining Co. 255
*Hutchison Manufacturing Co. 128

I

*Industrial Engine Division
Chrysler Corp. 190
*International Cementers, Inc. 200
*International Harvester Co. 187
The International Nickel Co. ..... 158 and 233

J

Jefferson Union Co. 272
*Jensen Brothers Mfg. Co. 168
*M. O. Johnston Oil Field Service Corp. 231
Johnston Oil Field Service Corp. 15
*Jones & Laughlin Steel Corp. 77

K

Kaiser Steel Corp. 195
Kern Directional Drilling Corp. 130
*King Oil Tools 232
*Kinzbach Tool Co. 14
*Kobe, Inc. 161

L

Lakewood Hotel 238
*Lane-Wells
Company ..... 17, 33, 205, 270 and III Cover
*Larkin Packer Co. 132
Lawn Hotel 238
*The Layne and Bowler Co. 12
*LeRoi Co. 94-95
Levingston Shipbuilding Co. 129
*Link-Belt Co. 3
*A. M. Lockett & Co. 237
Loma Alto Hotel 238
Lone Star Tool Co. 122
*Lucey Export Corp. 215
*Lufkin Foundry & Machine Co. 245
Lynn Hotel 238

M

Macwhyte Co. 5
*Magnet Cove Barium Corp. ..... II Cover
*Maloney-Crawford Tank & Mfg. Co. 164
*Jas. P. Marsh Corp. 169
Mayo Hotel 222
*McCullough Tool Co. 269
*McEvoy Co. 152-153
*Mid-Continent Supply Co. 270
*Miller Sand Pump Co. 170
*Mission Manufacturing Co. 125

N

*National Lead Co. 271
*The National Supply Co. 35-36-37-38
*National Tank Co. 141
National Tube Co. 72
New York Belting & Packing Co. 116-117
*Nordstrom Valve Division
Rockwell Manufacturing Co. 52-53
*W. C. Norris, Manufacturer, Inc. 151

O

*Walter O'Bannon Co. 268
*Oil Center Tool Co. 147
*Oil Well Manufacturing Corp. 246
*Oil Well Supply Co. 227
*Otis Pressure Control, Inc. 157

P

Pacific Coast Borax Co. 252
*Pacific Pumps Inc. 263
Parelex Corp. 238
*Parkersburg Machine Co. 198
*The Parkersburg Rig & Reel Co. 8
Pelican Well Tool & Supply Co. ..... 166 and 238
*Penberthy Injector Co. ..... 120, 166 and 228
Petroleum Distributing Co. 242
Petroleum Electric Power Association 181
Petroleum Specialty Co. 172
Piper Aircraft Corp. 197
Pittsburgh Coke & Chemical Co. 261
*H. K. Porter Co. 272
Property Credit Corp. 242

R

*Reed Roller Bit Co. ..... 81 and 111
*Reynolds Specialty Co. 230
*The Ridge Tool Co. 265
*Rockwell Manufacturing Co. ..... 52-53 and 257
John A. Roebling's Sons Co. 11
*Rolo Manufacturing Co. 254
The Royal Bank of Canada 250

S

*S & R Tool and Supply Co. 163
*Schlumberger Well Surveying Corp. 56
Seismic Explorations, Inc. 30
Seismograph Service Corp. 59
*Shaffer Tool Works 109
A. O. Smith Corp. 185
Southern Engine & Pump Co. 163
*Southern Mill & Manufacturing Co. 248
*Spang & Co. 244
*Sperry-Sun Well Surveying Co. 115
Standard Oil Company of California 6
*Standco Brake Lining Co. ..... 228 and 230
*Sunshine Iron Works 236

T

*Templeton, Kenly & Co. 130
Texas Employers Insurance Association 75
*Thermoid Co. 67
*Thompson Tool Co. 124
*Thornhill-Craver Co. 155
The Torrington Co. 101
Trading Post Section 266
*Tretolite Co. 131
Trojan Construction Co. 198
*Tube-Kote, Inc. 223
*Tuboscope Division
Tubular Service & Engineering Co. 107

U

*Union Wire Rope Corp. 64-65
United States Steel Corp. ..... 72 and 227
United States Steel Export Co. 72
*United Supply & Manufacturing Co. 119
*Universal Atlas Cement Co. 18

V

*Victaulic Company of America 16
*Visco Products Co. 7

W

*W-K-M Company, Inc. 249
*Walker-Neer Machine Co. 70
*Waukesha Motor Co. 179
*Weatherford Oil Tool Co. 103
Welex Jet Services, Inc. 93
John Wiley & Sons, Inc. 237
*Wilson Foundry & Machine Co. 69
*Wilson Manufacturing Co. 87

Y

The Youngstown Sheet & Tube Co. 174

Looking Ahead

REAL SOURCE of America's strength is tremendous productive capacity, and by tinkering with wages, prices, profits, credit, taxes, and our system of production and distribution, a single mistake could be fatal, declared Benjamin F. Fairless, president of U. S. Steel Corporation. No foreign aggressor can destroy us, but we may destroy ourselves, he said, and surest road to U. S. collapse is crippling the industrial machine.

MAXIMUM SUPPLIES for oil industry and other needs will depend greatly on sustained production and freedom from strikes. Magnitude of losses suffered by U. S. as direct result of recent railroad strike is seen in following figures: In one 24-hour period, in one U. S. Steel Corporation plant, 6000 tons of steel production were lost, an amount sufficient to produce 23 miles of 20-inch pipe or to drill 100 oil wells.

U. S. PETROLEUM INDUSTRY will continue to expand facilities through capital expenditures of at least $2 billion annually in 1951 and for some time thereafter if materials are available. Outlook for military and civilian demands for petroleum make such a minimum program necessary. Total investment in U. S. oil industry now stands at $32 billion, exceeding that for any other industry, though less than for agriculture, railroads and public utilities.

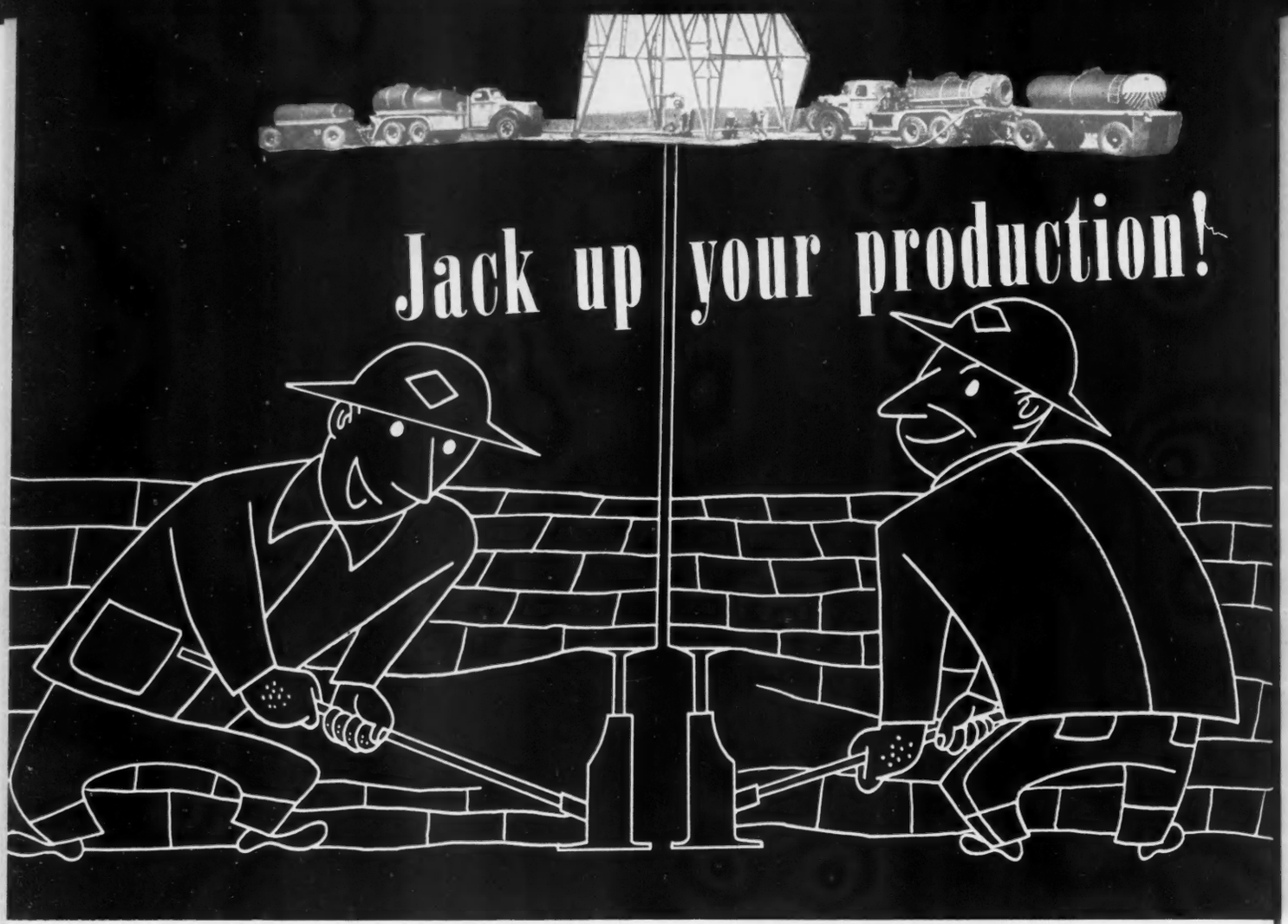
PAD HAS APPROVED about a dozen oil industry applications for the privilege of faster amortization of costs of plants and facilities for defense. These projects include new facilities for making aviation gasoline and benzine from petroleum and for storage of petroleum products.

IF PETROLEUM INDUSTRY is to expand oil availability of Western Hemisphere by 1 million barrels daily to assure national security, it must have climate in which it has heretofore operated, declared Dr. Robert E. Wilson, chairman of National Petroleum Council's committee on costs of such expansion. Features of needed climate, he indicated, include continuance of long-established tax provisions on depletion and intangible drilling costs and prompt settlement of tidelands dispute to permit further exploration and development of the submerged areas.

ADEQUATE TANKER CAPACITY for military requirements has been assured through pooling of facilities. Vessels will be signed up by the government on a voyage basis, and companies will distribute the burden of supplying the military as equitably as possible.

CONGRESS WILL BE ASKED to extend for four years the Interstate Oil Compact, which otherwise would expire this year. Of the 20 states in the compact, 15 already have approved continuance of the agreement.

AS IN WORLD WAR II, tightening oil supply likely will generate proposals for government sponsorship of synthetic oil production. Such production so far is too costly to compete with natural petroleum, and if and when it is needed, oil industry will provide it. A significant example of unsuccessful government sponsorship of synthetics is seen in recent decision of Australian government to close its shale oil field, condemned by its Treasury as a "criminal waste of the taxpayers' money."



DOWELL STRATALIFT *using* JEL-ACID provides an improved method of increasing production by fracturing formations

Jel-Acid, a recent Dowell development, is thickened hydrochloric acid. Forced into sand, dolomite or limestone formations at high pressure, it provides a fracturing effect that forms permanent new drainage channels. This process, called STRATALIFT, has proved highly successful for increasing production in many wells where ordinary acidizing or shooting failed to produce results.

A well completed in the Arbuckle had an initial production of 11 BOPD. A conventional acid treatment, a 10-quart shot of nitroglycerin and a second acid treatment all failed to increase production. STRATALIFT with Jel-Acid was then employed and the well is now producing 91 BOPD, *a 727% increase!*

STRATALIFT has many advantages. Jel-Acid provides the viscous fluid needed for formation fracturing and, in addition, reacts with the soluble part of the formation. Jel-Acid has a wide range of viscosities, easily controlled, making it adaptable to formations of various permeabilities. Further, Jel-Acid will not burn. Finally, Dowell, the pioneer in acidizing, has the right equipment for the job and the long experience needed for the best possible treatment. For complete information on this new development, call your nearest Dowell station or write to Tulsa.

DOWELL INCORPORATED
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

DOWELL
ACIDIZING SERVICE

Ask your nearest Dowell station for complete information on these Dowell services and products: Acidizing Service, Electric Pilot Services, Plastic Service, Chemical Scale Removal Service for heat exchanger equipment, Jelflake, Paraffin Solvents, Magnesium Anodes for Corrosion Control, Saran Rubber for corrosion resistant tank linings and Bulk Inhibited Hydrochloric Acid.

"First in Acidizing . . . since 1932"

Look to DOWELL

FOR OIL INDUSTRY CHEMICAL SERVICE

OIL NEEDS STEEL FOR ALL OPERATIONS

TO PROVIDE adequate military, industrial and civilian fuel energy to protect the nation's security, the U. S. oil industry is being called upon to produce, transport, and refine petroleum in greater quantities during 1951 than ever before.

Most important for this expanding oil program is steel, which surely will become of shorter supply as the armament program gains momentum. Without steel none of the industry's operations can be maintained at previous levels, let alone be enlarged to record volumes. Because steel likewise is a basic material for almost everything else that enters into the defense armament program, its equitable distribution among many claimants calls for careful judgment and planning.

Approval by the National Production Authority for allocation of 1,890,000 tons of oil country tubular goods during 1951 represents an encouraging outlook. However, there has been too much thinking only in terms of tubular goods, which will not of themselves drill any wells or produce any oil. There must be bits, wire line, rotary hose and countless other tools and machinery to drill wells. Then, something must be done for producing operations after oil is discovered, or there will be no benefits from drilling. Pumps, pumping units and other producing equipment will be required to bring the oil to the surface. It is equally important that transportation and refining be provided with steel products.

Present plans call for inauguration of a materials controlled plan on July 1. This is a vast undertaking. In the interim, when plans are being made, not after they have been made, is the time for oil to make sure authorities in Washington recognize the urgent need for steel if petroleum is to be available to fuel the nation's defense efforts.

INEQUITABLE OIL TAXES ASKED

AN UNDUE PORTION of the proposed increases in U. S. tax rates would fall on the petroleum industry and its consumers if Congress enacts recommendations of the Treasury Department.

Although the oil industry will bear the same increase in corporation taxes as any other business, the Treasury Department wants to saddle petroleum with an additional $200 million annually through reduction of its depletion allowance from 27½ to 15 percent.

Furthermore, the Treasury Department recommends that federal revenue be increased by $3 billion per year through new excise tax schedules. The gasoline tax would be doubled from 1½ to 3 cents per gallon, and the excise tax on new automobiles from the present 7 percent to 20 percent of the wholesale price. The treasury estimates that federal revenues from gasoline taxes would be increased by $580 million while the higher automobile tax would mean $685 million more annually. Thus, motor vehicle owners, largest users of petroleum, would pay $1265 million more per year, or 42 percent of the approximately $3 billion increase expected from higher excise taxes.

There can be no doubt but that the tremendous need for money will cause Congress to look carefully into every possible source. The industry must prepare to fight these inequitable tax increases with more vigor than ever before.

Warren L. Baker

You're right...

to want the best equipment for testing, acidizing, plasticizing, squeeze cementing —all of which are vital operations in well completion.

That's why you should use the Baker Model "RT-8" Retrievable Cementer, to provide a safe, positive device for...

- ***testing casing, or locating holes in pipe;***
- ***placing cement, plastic, acid, or any other fluid, at any necessary pressure, behind the casing or liner through perforations, or in open hole below the shoe;***
- ***setting in lime formations for acidizing or squeeze cementing;***
- ***pressure testing the effectiveness of a previously performed cement job.***

The Baker Model "RT-8" Retrievable Cementer (Product No. 411RT) is operated mechanically and is not dependent upon fluid pressure to set or release. It functions successfully in high-pressure wells, and will withstand with ample safety any pressure that may be imposed upon the well casing. It operates with equal efficiency and safety in low-pressure or low fluid level wells.

In addition to the obvious advantages of a "Retrievable" tool the Baker Model "RT-8" Retrievable Cementer has these outstanding features:

RUNS IN FAST—From 1 to 4 hours time is saved over the time required to run in a cementer equipped with swab cups;

RUNNING-IN STRING WILL NOT FLOW OVER while a Baker Cementer is being run-in hole at reasonable speed;

PERMITS CIRCULATING THE LONG WAY;

FUNCTIONS EFFICIENTLY IN LOW FLUID LEVEL WELLS as well as in high pressure wells;

PERMITS TESTING CASING, or protecting casing during squeeze job, by applying reasonable pressure to the annulus after cementer is set;

WITHSTANDS ANY PRESSURE below the cementer that is safe for the well equipment;

MAY BE ROTATED OUT OF THE HOLE—When the cementer is ready to be retrieved from the hole, rotation to the right will lock the slips in retracted position, thus preventing setting while coming out of the hole;

CIRCULATION POSSIBLE IF PACKING UNIT STICKS by means of a Circulation Joint above the cementer;

RELEASES IN EMERGENCY—Contains safety thread for quick release.

You can depend upon the Baker Model "RT-8" Retrievable Cementer

BAKER OIL TOOLS, INC.
Houston • Los Angeles • New York

It's the Best

The Changing Panorama

No Oil Sold Today; Must Go to Court

A DEPARTMENT of Justice anti-trust lawyer apparently loves details, is phenomenally inquisitive, and can ask questions faster than a roomful of four-year olds watching you drive a nail. "What are you doing? Why are you doing it? Where did you get that hammer? When did you get it? How much did it cost? Where did you get the nail? etc."

In connection with the anti-trust case against West Coast oil companies, Standard Oil Company of California has entered objections to certain interrogatories filed by the government, asserting that answers would involve research requiring 500 man-years of work by company personnel now busy providing oil for the nation's urgent needs. Hundreds of thousands of detailed answers are required by the interrogatories, covering 88 legal size double-spaced sheets and involving many immaterial and irrelevant facts.

You'd have to stop driving nails if required to document and prove your answers as to where you got the hammer, when you got it, what you paid for it, etc. The West Coast companies have more nails to drive and no time to waste searching for immaterial facts about those already driven.

The West Coast companies now assert that before going ahead with this case, the government should first dismiss or bring to trial a similar suit, the so-called Mother Hubbard case, filed ten years ago, on which no action has been taken.

Being dealt with at this critical time, the new West Coast antitrust case puts the spotlight on government-caused waste of manpower, time, and money in connection with antitrust suits that serve no constructive purpose. Standard of California has indicated the incredible waste involved, in protesting that for this company alone 500 man-years of work would be required to answer questions it has been asked, in dealing with only one phase of the suit. That is the equivalent of 500 men working one year, 100 men working five years, 50 men working ten years, or a dozen men working a lifetime. This is the chore asked of merely one company. Six other major West Coast oil companies face similar requirements.

In other parts of the country, too, oil companies must spend much time and money defending themselves against charges of antitrust law violations. It is significant that some of the complaints have been not against high prices charged for oils, as might be expected under monopolies, but against low prices, allegedly maintained to drive out competition. The fault lies basically in vague and conflicting antitrust laws and shifting interpretations of the laws, which need to be overhauled and brought under clear and consistent government policy as determined by Congress.

Original laws were designed to prevent real monopolies and encourage competition, but under later laws and new court interpretations of the laws, the government wavers from its purpose of encouraging and promoting competition by seeking to protect certain competitors against the low prices of other competitors. In other words, the government wants competition but it does not want competition, and it stretches the meaning of existing laws to charge an oil company with monopoly if its prices match or exceed those of competitors or with unfair competition if its prices are below those of competitors.

Antitrust cases against oil companies are wasteful and against the public interest unless they can be based on strong, concrete evidence of real monopoly that restrains competition and increases prices of oils. Such evidence would be extremely hard to find in the highly competitive oil industry, as proved by the borderline nature and generalities of charges in suits that have been filed.

Gas Industry Shows Faith in U. S. Future

FAITH IN this country's ability to surmount its moment of greatest peril will assure to millions of Americans the benefits of natural gas. This industry, which in five years has doubled its value to become a giant enterprise worth $10 billion, plans to go ahead with an expansion program unrivaled in its history. War clouds and economic controls will not swerve the industry from efforts to carry out its five-year plan announced at the end of 1949. The plan calls for expenditures of approximately $3154 million of which about $2750 million is earmarked for new pipe lines and other facilities.

D. A. Hulcy, president of Lone Star Gas Company, Dallas, speaking for the industry in his capacity as president of the American Gas Association, admitted that the future looks uncertain, but declared that the five-year goals still stand and that the natural gas industry has allocated approximately $1 billion for expansion and construction in 1951.

During the first nine months of 1950 approval was obtained for construction of 5750 miles of new natural gas transmission lines. Applications are pending for construction of another 12,400 miles. Construction of lines already approved will bring the nation's network of natural gas transmission lines to a total of 265,000 miles.

Densely populated areas in New York and New England will have the advantages of natural gas, which many consider the ideal fuel, when the 1900-mile pipe line—longest in the world—is laid from the prolific gas areas of the Southwest to metropolitan New York. From there a criss-cross network of transmission lines will carry natural gas to New England cities and towns.

Behind this ambitious program are natural gas reserves which at the beginning of 1950 were estimated at 180.3 trillion cubic feet, ample to keep pace with the nation's expanding economy.

Despite these huge reserves the natural gas industry intends to intensify its search for additional natural gas, especially in the tideland belt and the Louisiana and Texas shorelines, where experts predict there are huge reserves still to be proved.

The natural gas industry, once the stepchild of the oil industry, has come of age. Although closely geared to oil operations and facing similar problems, the natural gas industry has taken its own place in the economic pattern of American life.

Report from the Observatory

Weather, Defense Intensify Demand

By **RAY L. DUDLEY**, Publisher, and **L. J. LOGAN**, Associate Editor

DURING JANUARY and February the industry was called upon to supply unexpectedly heavy requirements for its products. Demand generally would have been at record levels on the basis of normal use by unprecedented numbers of automobiles, trucks, oil burners, diesel locomotives, and other oil-consuming units in use. But on top of normal use came protracted abnormally cold weather that greatly increased demand for heating oil and fuel oil. Stepped-up defense activities also possibly required more petroleum products than expected.

In order to meet the heavy demand for heating oil, the industry maintained refinery runs at record levels in January and February and pushed U. S. crude production also to record highs, slightly above the peak of last fall. Runs to stills averaged approximately 6.4 million barrels per day in both January and February, compared with somewhat less than 6.1 million daily in the last three months of 1950. For January-February of last year, runs to stills averaged only about 5.4 million barrels per day. The runs in this year's first two months therefore were 1 million barrels a day or 18.5 percent above those in the like months last year. Partly explaining this great increase is the contrast in weather, for while early 1951 was abnormally cold, early 1950 was warmer than normal. It is estimated that for January, 1951, the demand for distillate fuel oil was about 28 percent greater than in January, 1950.

Domestic production of crude averaged a little more than 5.9 million barrels daily in both January and February, 1951. This was only a little more than output in the last several months of 1950 but was 1 million barrels per day or 20 percent more than the production of about 4.9 million daily in January-February, 1950.

Although no official figures are available as to present U. S. crude producing ability, it is indicated that the total may be around 1 million barrels above the 5.9 million per day actually produced currently, with Texas probably able to produce at least 650,000 a day more than the 2.6 million actually being produced. These figures are based on data compiled by the Interstate Oil Compact Commission as of July 31, 1950 WORLD OIL, September, 1950, page 41), which indicated U. S. crude producing ability of about 6.8 million barrels daily at that time.

• • •

REFINERY RUNS have necessarily been maintained at record levels in order to produce enough heating oil to meet requirements, although there have also been heavy drafts on stocks of heating oil for part of needed supply. Following weeks of heavy withdrawals to meet cold weather needs, U. S. stocks of distillate fuel oil were down to 49,420,000 barrels on February 17, having shrunk 3,645,000 barrels in only the one week ending that date. The new total was less than the stocks held one year previously by 8,670,000 barrels or 14.9 percent. East of California, distillate stocks of 40,699,000 barrels held February 17 were 7,039,000 barrels or 14.7 percent less than the 47,738,000 barrels on hand one year previously. The presently held distillate fuel oil stocks, nearly 15 percent smaller than a year ago, are comparatively low, especially in view of the fact that distillate demand for 1951 is expected to be more than 7 percent greater than in 1950. This situation will call for refinery operations in 1951 resulting in needed buildup of distillate stocks. No serious difficulty was experienced in recent cold weather in meeting the demand for distillate fuel oil, but some trouble was caused by the railroad strike, which prevented normal deliveries. The industry will have to guard against inadequate heating oil stocks during next winter's heating season.

• • •

KEROSINE STOCKS, like those of heating oil, are now substantially lower than a year ago, although demand is running higher than previously. In the week ended February 17, kerosine stocks decreased 1,379,000 barrels and then stood at 13,314,000 barrels. That was 3,802,000 barrels or 22.2 percent less than the 17,116,000 barrels held one year before. East of California, kerosine stocks February 17 totaled 12,728,000 barrels, which was 3,645,000 barrels or 22.3 percent less than one year earlier. While kerosine stocks are at these relatively low levels, the demand for kerosine in the year 1951 is expected to be about 7.5 percent larger than in 1950.

U. S. stocks of residual fuel oil totaled 39,874,000 barrels February 17, having declined 332,000 barrels within a week, and then compared with 51,336,000 barrels held a year before. This indicated a decrease of 11,462,000 or 22.3 percent from a year previously. East of California, residual stocks of 21,751,000 barrels held February 17 were 1,901,000 barrels or 8.0 percent less than one year before.

U. S. stocks of finished and unfinished gasoline have been increased relatively sharply as refinery runs were high in meeting need for heating oil, but the gasoline stocks have not become burdensome. In the seven weeks ending February 17, U. S. stocks of finished and unfinished gasoline increased more than an average of 2½ million barrels per week. It was still six weeks until the end of March, until which time additions to gasoline stocks could be expected to continue. On February 17, the stocks totaled 134,598,000 barrels, 3 million above 1950 levels. This would indicate that stocks will be at least this much greater than a year ago when the consuming season arrives April 1, and thus may total 140 million barrels in contrast with 135,586,000 on March 31, 1950.

piping repairs cost more now!

No. 488 Iron Body Clamp Gate

You make them less often by using Dependable Quality

CRANE VALVES

...That's why more Crane Valves are used than any other make

easy access prevents trouble with this valve

Remove just two nuts to dismantle this gate valve for inspection, cleaning, or repairs—without taking it from the line. Reassemble just as easily, knowing that Crane clamp design keeps the bonnet joint snug and accurately aligned. Use Crane Clamp Gates on steam, water, and air, but especially in heavy fluid lines needing periodic cleanout. They'll save time, labor, and encourage regular servicing that prevents valve trouble.

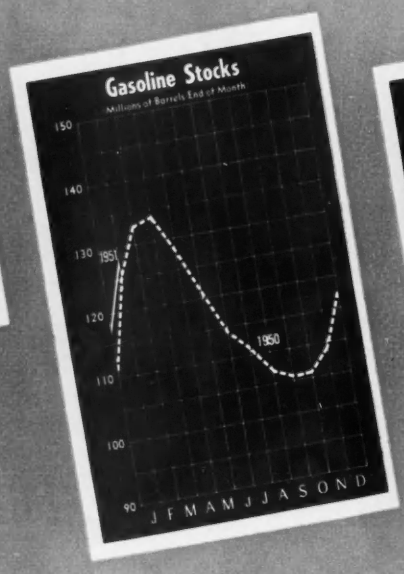
Combining easy access with highly dependable service features, Crane Clamp Gates typify Crane Quality—*better valve performance at lowest ultimate cost.*

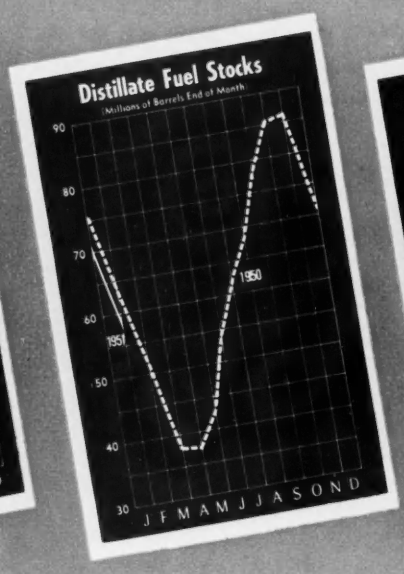
CRANE

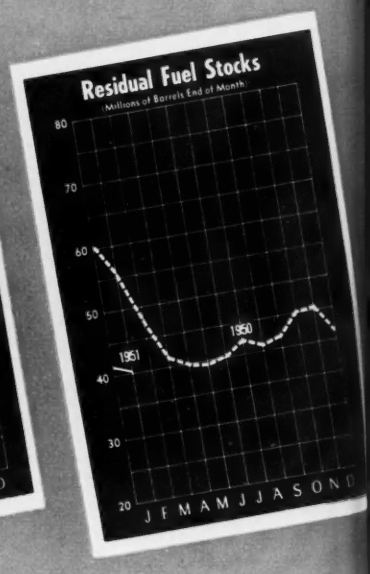
CRANE CO., *General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

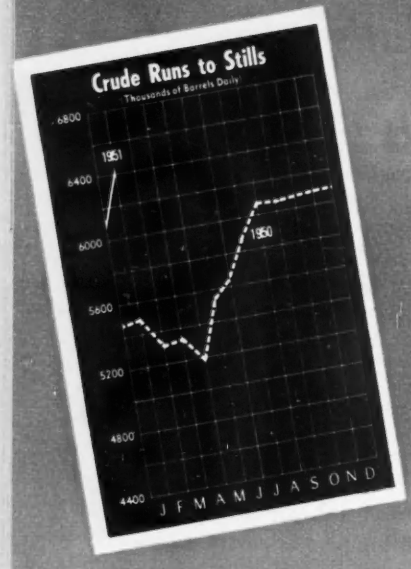
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

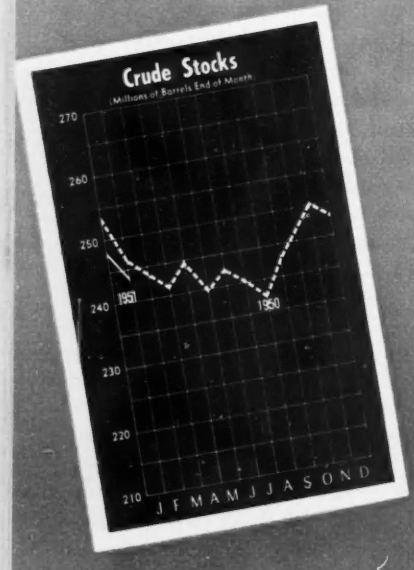
Petroleum









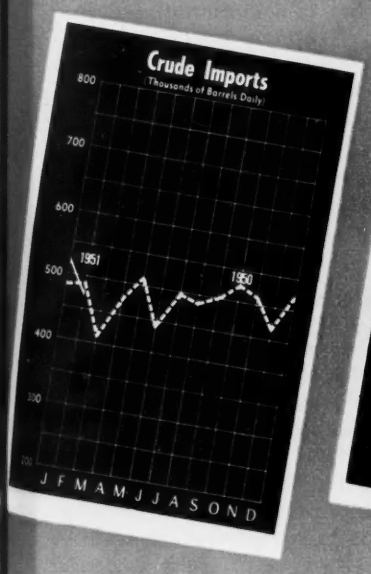


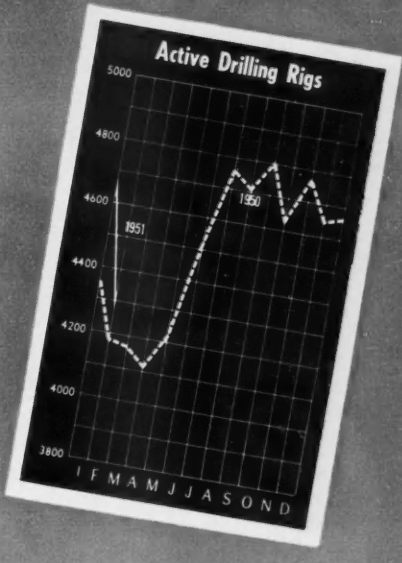
State Crude Production

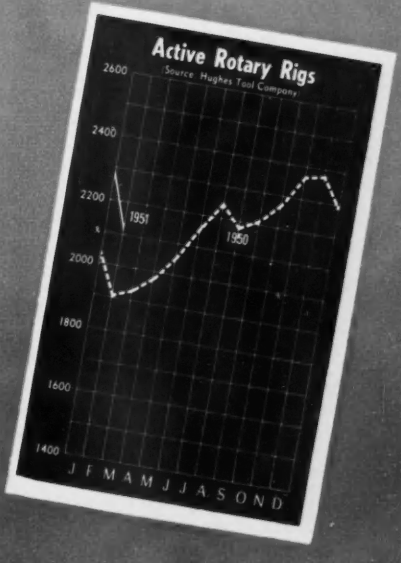
(THOUSANDS OF BARRELS)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL PRODUCTION		
	January, 1951	December, 1950	January, 1950	% Diff. January, '50-'51	January, 1951	January, 1950	% Diff. '50-'51
Alabama	2.7	2.7	1.6	+ 68.8	84	49	+ 71.4
Arkansas	84.4	86.1	86.1	— 2.0	2,625	2,668	— 1.6
California	967.1	961.2	867.5	+ 11.5	29,979	26,894	+ 11.5
Colorado	77.4	78.0	60.6	+ 27.7	2,399	1,889	+ 27.0
Florida	1.5	1.5	1.0	+ 50.0	47	32	+ 46.9
Illinois	166.2	171.1	165.2	+ 0.6	5,151	5,120	+ 0.6
Indiana	29.1	30.5	23.6	+ 23.3	903	732	+ 23.4
Kansas	308.7	310.8	270.4	+ 14.2	9,569	8,381	+ 14.2
Kentucky	29.8	30.8	22.2	+ 34.2	925	688	+ 34.4
Louisiana	622.1	616.3	560.5	+ 11.0	19,284	17,376	+ 11.0
North Louisiana	127.6	125.7	123.9	+ 3.0	3,955	3,841	+ 3.0
South Louisiana	494.5	490.6	436.6	+ 13.3	15,329	13,535	+ 13.3
Michigan	43.0	41.8	44.6	— 3.6	1,333	1,383	— 3.6
Mississippi	105.9	106.5	97.7	+ 8.4	3,283	3,029	+ 8.4
Missouri	0.1	0.1	0.1	.....	2	2	.....
Montana	24.7	24.1	19.7	+ 25.4	766	610	+ 25.6
Nebraska	8.4	5.9	1.8	+366.7	260	56	+364.3
New Mexico	132.8	129.4	131.2	+ 1.2	4,118	4,069	+ 1.2
New York	13.8	13.9	11.8	+ 16.9	429	365	+ 17.5
Ohio	9.0	7.9	9.1	— 1.1	278	282	— 1.4
Oklahoma	496.4	496.0	393.8	+ 26.1	15,388	12,209	+ 26.0
Pennsylvania	29.8	29.2	30.8	— 3.3	924	954	— 3.2
Tennessee	0.1	0.1	0.1	.....	4	4	.....
Texas	2,577.1	2,423.1	1,961.6	+ 31.4	79,890	60,809	+ 31.4
Dist. 1—South Central	32.4	31.1	26.2	+ 23.7	1,005	813	+ 23.6
Dist. 2—Middle Gulf	155.0	144.5	114.8	+ 35.0	4,803	3,559	+ 35.0
Dist. 3—Upper Gulf	470.5	446.7	375.8	+ 25.2	14,587	11,649	+ 25.2
Dist. 4—Lower Gulf-S.W.	239.5	222.1	180.9	+ 32.4	7,426	5,607	+ 32.4
Dist. 5—East Central	46.1	40.5	32.7	+ 41.0	1,429	1,014	+ 40.9
Dist. 6—Northeast	377.3	367.2	306.9	+ 22.9	11,697	9,515	+ 22.9
Dist. 7-B—North Central	77.5	72.7	62.3	+ 24.4	2,403	1,932	+ 24.4
Dist. 7-C—West Central	85.7	80.3	47.0	+ 82.3	2,656	1,457	+ 82.3
Dist. 8—West	845.8	778.6	573.6	+ 47.5	26,219	17,781	+ 47.5
Dist. 9—North	157.3	149.3	142.7	+ 10.2	4,875	4,423	+ 10.2
Dist. 10—Panhandle	90.0	90.0	92.4	— 2.6	2,790	2,864	— 2.6
Utah	3.7	3.5	3.2	+ 15.6	113	88	+ 28.4
Virginia	0.1	0.1	0.1	.....	3	3	.....
West Virginia	7.2	7.0	7.7	— 6.5	223	240	— 7.1
Wyoming	182.5	179.4	150.2	+ 21.5	5,657	4,658	+ 21.4
Total United States	5,923.6	5,757.8	4,922.2	+ 20.3	183,637	152,590	+ 20.3

Trends in U. S.







Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1949:											
January...	5,365	5,641	258,648	2,538	116,621	1,063	61,584	1,348	62,508	456	629
February..	5,376	5,480	265,216	2,484	126,054	1,004	53,937	1,282	59,398	446	601
March....	5,224	5,352	269,341	2,470	127,443	993	48,923	1,258	58,190	358	522
April....	5,012	5,141	272,520	2,494	125,351	846	51,231	1,147	59,668	398	593
May.....	4,972	5,195	273,912	2,585	121,602	813	57,442	1,138	63,576	409	572
June.....	4,903	5,162	274,691	2,597	114,041	771	64,730	1,041	64,628	400	598
July.....	4,704	5,173	267,586	2,613	111,217	835	71,553	1,040	66,084	428	624
August....	4,780	5,241	260,585	2,593	104,879	902	76,037	1,078	66,843	413	614
September.	4,940	5,427	251,689	2,617	101,799	1,002	83,213	1,110	67,117	374	623
October...	4,997	5,373	250,932	2,643	103,287	1,001	90,643	1,141	68,673	492	785
November.	5,210	5,293	256,010	2,594	104,707	962	88,212	1,180	65,112	435	703
December.	5,024	5,475	253,356	2,633	111,521	1,032	75,207	1,203	60,193	485	828
1950:											
January...	4,922	5,483	246,610	2,575	125,298	1,048	63,932	1,209	55,808	487	841
February..	4,967	5,316	243,750	2,552	132,796	1,026	52,206	1,172	47,828	411	684
March....	4,878	5,336	241,098	2,539	133,766	938	37,777	1,154	41,860	471	869
April....	4,968	5,193	244,605	2,508	128,057	977	37,530	1,048	39,979	511	888
May.....	5,143	5,535	239,877	2,647	121,035	997	42,739	1,063	39,482	439	766
June.....	5,378	5,655	242,287	2,748	114,074	1,037	53,679	1,069	40,124	498	838
July.....	5,484	5,882	240,270	2,835	111,055	1,040	62,555	1,140	42,165	486	806
August....	5,665	6,067	237,393	2,932	107,067	1,089	68,426	1,148	40,979	501	839
September.	5,888	6,059	242,311	2,849	105,748	1,180	78,270	1,178	41,966	525	859
October...	5,900	6,077	246,424	2,875	105,764	1,217	85,643	1,250	45,004	510	896
November.	5,891	6,085	250,016	2,859	109,005	1,218	86,113	1,240	45,048	466	891
December.	5,758	6,092	247,814	2,872	117,220	1,307	70,875	1,280	41,184	521	979
1951:											
January...	5,924	6,425	243,412	2,971	128,226	1,392	57,728	1,384	40,374	473	920
Jan., 1951 Change:											
In Month.	+166	+333	—4,402	+99	+11,006	+85	—13,147	+104	—810	—48	—59
In Year...	+1,002	+942	—3,198	+396	+2,928	+ 344	—6,204	+175	—15,434	—14	+79
Week Ended:											
Feb. 10, 1951	5,861	6,338	238,873	2,867	133,134	1,346	53,065	1,388	40,206	596	982
Feb. 11, 1950	4,951	5,362	245,450	2,555	129,362	963	60,602	1,242	52,865	....	....

Monthly News Analysis

Industry Faces Difficult Task in Tax Law Dispute

The petroleum industry faces a distinct threat of unfavorable change in long-established provisions of the federal income tax law, in view of government need for increased revenue to cover heavy mobilization costs. In jeopardy are both the percentage depletion allowance and the option to expense or capitalize intangible drilling costs.

President Truman asked Congress for changes in tax provisions applicable to oil and mining industries, and Secretary of Treasury Snyder followed through with details of proposed changes. Snyder asked the House Ways and Means Committee to cut "the highly favorable" depletion allowance from 27.5 percent to 15 percent. He also said that "oil and gas operators who elect to expense intangible drilling and development costs should be required to make corresponding adjustments in the basis for computing their percentage depletion." He declared that "This would mitigate the double deduction which compounds the potentialities for tax reduction under the present treatment."

Oil men generally are resigned to higher taxes for defense financing but feel that extra taxes should be spread out generally and that they should not be singled out to take on a special new burden such as would be involved in tampering with the long-established and well-justified provisions on percentage depletion and expensing of intangible drilling costs. These provisions have been attacked in Congress several times, as in 1942 and again in 1950, but in each instance they have been justified convincingly enough for Congress to retain them. They are needed to keep the income tax from being a tax on capital (oil removed from under a lease and sold) and to permit an operator to deduct from taxable income (as expense) what he spends in drilling dry holes that never will produce income to otherwise apply the cost against.

Oil men already have shown, but now will have to prove again, that these tax provisions are not loopholes but fair and practical means of avoiding taxation and eventual confiscation of capital (disguised as tax on income from capital). It will have to be proved again, as it has been proved before, that the 27½ percent depletion allowance closely approximates the rate that the Treasury has to allow over the years to cover the using up of capital in connection with deriving income from production of oil. It must be shown again that the tax provisions are conclusively justified because they result in rates of profit from oil production no higher than from business in general, even though risks of capital employed are greater.

At the middle of February the House Ways and Means Committee had been asked by 44 oil industry witnesses for time to testify on the Treasury's proposal to reduce the depletion allowance from 27½ to 15 percent. The committee was expected to give about two days for presenting testimony on the question and to ask that witnesses consolidate their testimony.

NPA's Materials Plan May Be in Operation July 1

National Production Authority hopes to have in operation by July 1 the Controlled Materials Plan under which petroleum industry's steel and other requirements will be coordinated with those of other users. Toward this end, Petroleum Administration for Defense was under orders from NPA to submit by March 1 schedules of materials required by all branches of oil and gas industries.

Action of NPA has been toward directing increased proportions of steel toward mobilization. At mid-February the agency ordered steel producers to raise the proportion of total production reserved for defense orders from 23 to 25 percent. Percentages were increased for steel sheets. Oil country tubular goods, though scarce, were not being reserved for defense orders by NPA, and the 5 percent set aside for line pipe remained unchanged.

In accordance with PAD recommendations, NPA proposes to channel tubular goods to the petroleum industry at the rate of 1,890,000 tons annually, beginning April 1, to permit the drilling this year of 43,400 new wells. (In 1950, about 1,700,000 tons of oil well pipe was turned out, and 43,200 new wells were completed in the U. S.) It is contemplated that 5 percent of tubular goods produced will be reserved for wildcat and offset wells, under plans to be in operation in the second quarter. An additional 10 or 15 percent would be set aside, under PAD proposals, for unplanned expansions.

Public Being Informed of Industry's Responsibility

In this period of controls and threats of more controls, nothing is more important to America than to keep in mind that mobilization is for the purpose of preserving the freedom of Americans, including freedom in economic affairs as in religion, politics, and other things.

The petroleum industry's current public relations program, handled through the American Petroleum Institute, therefore is a patriotic effort and service. The Oil Industry Information Committee has reshaped its program for this year to focus public attention on the increased responsibilities that mobilization places upon the industry.

Realizing that mobilization will greatly affect the industry, the committee has restated its basic objective: "To help reaffirm the faith of the American people that their individual interests, as well as those of the nation, in peace or in war, are best served by competitive, privately managed oil companies."

During the year emphasis will be given to the responsibility placed upon the industry by the public and the ways in which the vigor and strength of the industry enable it to meet those responsibilities.

"The oil industry faces a tremendous job, and we will try to show how thoroughly oil men are doing that job," said John L. Dupree, national OIIC chairman. It will be stressed that the reason the oil industry is able to perform its task is that is has grown as a free, competitive industry.

The plans of the committee for the year were formulated at its first quarterly meeting of 1951, a three-day session in Houston in early February.

Congress Giving Attention To Imports Duty Provisions

Congress in February was taking action on the Trade Agreements Act under which imports, including oils, are admitted at tariffs less than those prescribed by law through trade agreements made by the Executive Department.

At mid-February the matter was before the Senate after the House had voted to extend the Trade Agreements Act for another three years, with several amendments added to curb the broad powers that the Executive Department has exercised in admitting imports. One of the amendments adopted by the House is the "peril point" provision, which requires the Tariff Commission to determine the point below which a duty cannot be cut without causing injury to the domestic industry concerned. Another is an "escape clause" provision, which requires that if a reduced duty causes injury it may be modified or suspended or corrected by the establishment of import quotas.

Under these amendments the Tariff Commission will be required to make an investigation and hold pubhearings. Heretofore, as occurred in 1949, the Tariff Commission has arbitrarily dismissed applications for relief without holding hearings or even making findings or conclusions.

Oklahoma Pool Speaks for Soundness of Unitization

An outstanding example of what can be achieved under unitization and the application of sound engineering and conservation practices is furnished in a report by Phillips Petroleum Company to the Oklahoma Corporation Commission in connection with operations in the West Cement Medrano Sand Unit pool of Caddo County in Oklahoma.

Here is a pool which, under poor operating techniques, would now have passed half the span of its economic productive limit. Certainly billions of cubic feet of gas and many millions of barrels of oil would have been lost to the state and nation. But, by applying sound engineering principles under a unit operation there has been added an estimated seven years' additional productive life and about 6 million barrels additional oil for this 3280-acre reservoir.

Application to operate the reservoir as a unit was made in 1947 and operators favoring the unit-operation estimated a total recovery of 44 million barrels from the reservoir in 21 years. Latest calculations indicate the ultimate recovery will reach 50 million barrels and the life expectancy of the pool is now 28 instead of the originally estimated 21 years.

Under primary methods the recovery was estimated at 23.5 million barrels. To date the pool has produced nearly 11 million barrels.

The first gas well was completed in the Medrano sand zone of the Cement pool in 1936 and the first oil well in 1943. Production of both the oil and gas zones resulted in commingling of both products, with the high-pressure gas migrating down structure into the oil zone. At its peak the field produced nearly 68 million cubic feet of gas per day. This was cut back to 23 million when the operation was unitized in December, 1947.

Under the unit program all gas wells and high gas/oil ratio wells were shut in, cutting gas output to about 7 million cubic feet per day by July 1, 1949, when injection gas was started. Salt water, which had broken into the oil zone along the edge of the pool, is now returned to the horizon as additional pressure maintenance medium. Gas injection into the reservoir halted the decline in reservoir pressure and has resulted in a high oil recovery per pound of pressure decline. Prior to unitization the pressure decline was one pound per 16,000 barrels of produced oil. Today the pool is producing 58,000 barrels of oil per pound of decline or a recovery of 250 percent more oil per pound drop in pressure.

Before unitization, 9 percent of oil produced from the reservoir was produced with 56.2 percent of the reservoir gas. Since unitization there has been produced an additional 4.9 percent of oil by utilizing only 3.4 percent of the reservoir gas.

New Locomotive Consumes Heavy Types of Fuel Oils

A glimpse into the future of petroleum use by railroads is provided by Union Pacific Railroad Company's order of ten 4500-horsepower gas turbine electric locomotives. The original developmental unit of this type engine for the past 1½ years has been undergoing extensive road tests.

Of particular significance and interest to the oil industry is that this latest type locomotive is designed to use the low cost, heavy types of fuel oils.

Although they outwardly resemble the conventional diesel electric locomotive, these units can develop two to three times the amount of power in the same space as a diesel.

Congress May Dare Veto With Tidelands Quitclaim

Some possibility now exists that Congress may attempt to pass tidelands quitclaim legislation again and subsequently override the presidential veto it doubtless would invoke. Such legislation was enacted in 1946 but vetoed by President Truman, and the Supreme Court subsequently has upheld federal government claim to the submerged areas.

In late February, 35 U. S. senators introduced legislation to quitclaim the tidelands to the adjoining states. The measure was introduced after the claim was made that there were sufficient votes in favor of state ownership to override an almost certain presidential veto.

The decision to try to settle the tidelands dispute in this conclusive way was made in the course of hearings on the previously introduced O'Mahoney-Anderson "interim" tidelands bill, which would authorize the Department of Interior to administer the disputed areas pending a final settlement by Congress. This bill had been accepted by spokesmen for offshore operators, though they preferred state ownership and regulation, because it appeared to be the only way in which development of the tidelands could be continued. It was pointed out that they had to operate under the mandate of the U. S. Supreme Court. The interim bill was vigorously opposed, however, by some members of Congress, who declared that its enactment would prejudice state claims and tend to make federal control of the tidelands permanent. These opponents of interim legislation advocated quitclaim legislation instead.

It is conjectural whether or not quitclaim legislation could be passed in both Senate and House by the two-thirds majority needed to override a veto. It is indicated, however, that the possibility of overriding a veto is stronger in the new Congress than it would have been in the preceding Congress, considering Republican gains of seats and the Republican party's position favoring state ownership of the tidelands. Also possibly strengthening quitclaim legislation is the need for early decisive action to end controversy and promote prompt development of tidelands oil to help meet defense requirements.

Price-Wage Controls Cut Production

By L. J. LOGAN, Associate Editor

THE MOST serious freeze of January was not the one that came in from the North and gripped the nation in ice and snow but the one that struck the country out of Washington, D. C., congealing prices and wages, in the name of national defense. Prices of oils were frozen, along with some but not all other commodities. Administrators issued decrees, and the American free, competitive economy went into the strait jacket it had escaped with difficulty in late 1946.

At its beginning the new price control program involved inequalities between oil prices and the prices of goods and services required by the oil industry. Prices of oils were less than 1 percent above the pre-Korea level, while all commodities in the aggregate were nearly 14 percent above June, 1950. Having held the line on prices in spite of rising costs, the industry now is forestalled from making adjustments in prices to compensate for increases in costs of materials, labor, and services.

Within the industry, prices must stay as they were, at well, refinery, terminal, and retail outlet, although various groups and areas are thus tied to abnormal or unsatisfactory prices or margins that happened to exist at the time of the freeze, under the usual strains and stresses of a highly competitive industry. To secure adjustments may be possible but hardly worth attempting, considering cost in time, effort, red tape, and exasperation.

Future inequities and roadblocks to finding, producing, refining and moving oils are inevitable under frozen prices, as the oil prices of 1950 fitted conditions of that year but will not fit conditions of coming years. The function of price as applied to petroleum is to balance supplies of the different oils with requirements of those oils. As requirements change, supplies will no longer respond, in absence of freedom of prices to rise or fall and thereby increase or reduce the supplies offered.

Present prices fitted 1950 refinery yields but may not encourage refiners to make in proper volumes the various products needed in 1951 or 1952. The frozen prices probably will promote scarcities of some crudes and some products and place special disadvantage on certain suppliers and consumers and certain areas. For instance, heavy crudes and fuel oils have been frozen at levels subnormal in relation to other oils, providing the basis for possible future shortages of heavy crudes and fuel oils. Military or industrial needs may require abnormal and costly transportation of oil, as by tank cars or trucks for long hauls, but ceiling prices will not cover the extra costs.

To meet such problems as these, the government must take action tantamount to admitting the failure of price controls. It must raise ceilings and thereby undermine the price control program for a future cave-in, or it must invoke subsidies to cover costs, requiring that a part of the necessary price be paid by the general public instead of the consumer. (The consumer gets only an apparent bargain, as all subsidy costs come out of his pocket.)

Creeping Socialization

Many thinking people, including spokesmen for farmers and labor organizations, as well as political and business leaders, now are voicing sentiment against the philosophy and practical results of wage and price controls. They have called these controls unsound, ineffective, and destructive of freedom and initiative; and have said they will restrict production and reduce the nation's economic strength. Some have charged, further, that the controls are primarily a part of the movement toward socialization, conveniently explained as necessary for national defense.

America's national security lies basically in its awe-inspiring productivity, which has been achieved by means of a free, competitive economy—not by means of government decrees and controls. In the interest of national security, American productivity now is urgently essential, and the logical way to achieve it is the way it has always been achieved: through a free functioning economy—not one gummed up and slowed down by controls and prohibitions.

Even their advocates concede that price and wage controls are employed not to maximize production but ostensibly to try to control inflation, which is the deterioration of the value of the dollar.

The true value of the dollar depends not on the price at which a producer sells a barrel of crude or the wage he pays a pumper but on the government's handling of its financial affairs. If the government wants prices and wages stable, it must make the value of the dollar stable, and that is strictly a problem of sound financing—of budget balancing and protection of the government's credit rating.

Fortunately, the importance of sound government financing of heavy defense costs is widely recognized, as evidenced by strong support of a "pay as we go" policy.

The sound financing that would control inflation, leaving no excuse for price and wage controls, would involve primarily an earnest effort toward budget balancing—balancing of government expenditures with government revenue. Keeping expenditures in hand requires minimum nondefense spending and efficiency in defense spending, while adequate revenue requires higher but equitable taxes and encouragement of production from which taxes must come.

If spending for national security requires more funds than government revenue produces, the deficit can be raised without inflationary effect only by selling government bonds to individuals and other investors, who will be lending their savings. The deficit cannot be financed without inflation and reduction of the value of the dollar by the hocus-pocus through which the government sells bonds to banks, the banks set up deposits in like amounts for the account of the government, and the government checks against the account to pay contractors or purchase goods or services, putting into circulation new money based on debt and not on assets or real value. Under such monetizing of government debt and watering down of the dollar, inflation is inevitable and beyond the power of price and wage controls to stop.

YOUR LANE-WELLS MAN CAN GIVE YOU ALL THESE ANSWERS ON PACKERS!

1. DO I NEED A PACKER?

Analysis of well conditions often reveals that a packer, though applicable, would be less desirable than some other piece of equipment. Lane-Wells men recommend the tool best suited to your needs.

2. WHAT CAN PACKERS DO FOR ME?

Operators are sometimes surprised to find how wide a variety of oil field operations packers perform. Lane-Wells men can work out with you packer settings for a range of down-the-hole jobs.

3. WHICH PACKER IS RIGHT FOR THIS JOB?

Most operators are aware that different types of packers can be used—but only one is really right for the job. Your Lane-Wells field man can help you select that one right packer.

4. HOW TO SET THIS PACKER?

There are at least 15 different factors which must be taken into account to assure a proper packer setting. Lane-Wells field men lay out packer settings on which you can rely.

5. HOW ABOUT PULLING A PACKER?

Pulling a packer involves as many factors as setting. Your Lane-Wells packer expert plans procedures which pull packers efficiently.

6. HOW TO GET THE MOST FROM A PACKER.

Your Lane-Wells man can review your packer programs, tell you how to evaluate their efficiency, and show you what to expect from a packer.

7. IS THIS PACKER STILL GOOD?

Many used packers have been saved for further service by Lane-Wells field men, who can advise on proper maintenance and on both field and shop repair and reconditioning.

Ask Your

LANE-WELLS MAN

NOW

...and get ALL the ANSWERS!

This Service is FREE!

Engineered PACKER SERVICE

...by...

General Offices, Export Office and Plant • 5610 So. Soto St. Los Angeles 58, California

LANE WELLS

Los Angeles • Houston • Oklahoma City
Lane-Wells Canadian Co. in Canada
Petro-Tech Service Co. in Venezuela

Completions

Up 11.5 Percent

WELLS completed during January totaled 3766, the greatest number ever recorded in a comparable month, to get the 1951 drilling program off to a fast start. Last year when the all-time record of more than 43,000 wells were drilled, the total credited to the initial month was 3377, or 11.5 percent less than were completed in the month just passed.

Although the total amount of footage represented in those wells set a record for January, it was not as great a gain over the previous January's as was the number of wells. Footage totaling 14,257,296 feet was drilled in January's wells and that amount figured to be 10.2 percent greater than the 12,942,113 feet credited to January, 1950, while the number of wells differed by 11.5 percent. The latest month's new wells were 3853 feet deep on the average, while a year before each was carried to 3868 feet.

At the beginning of the year, the outlook for 1951, as estimated by WORLD OIL in its Review-Forecast issue, was an increase of 4 percent in the number of wells drilled over 1950 and an increase of 7 percent in total footage.

Several leading oil activity states were the sites of increased work during January, but several principal areas recorded declines. Texas, as is generally the case, reflected the national average. That state's wells were up 11.4 percent over last year's and the U. S. average gained 11.5 percent.

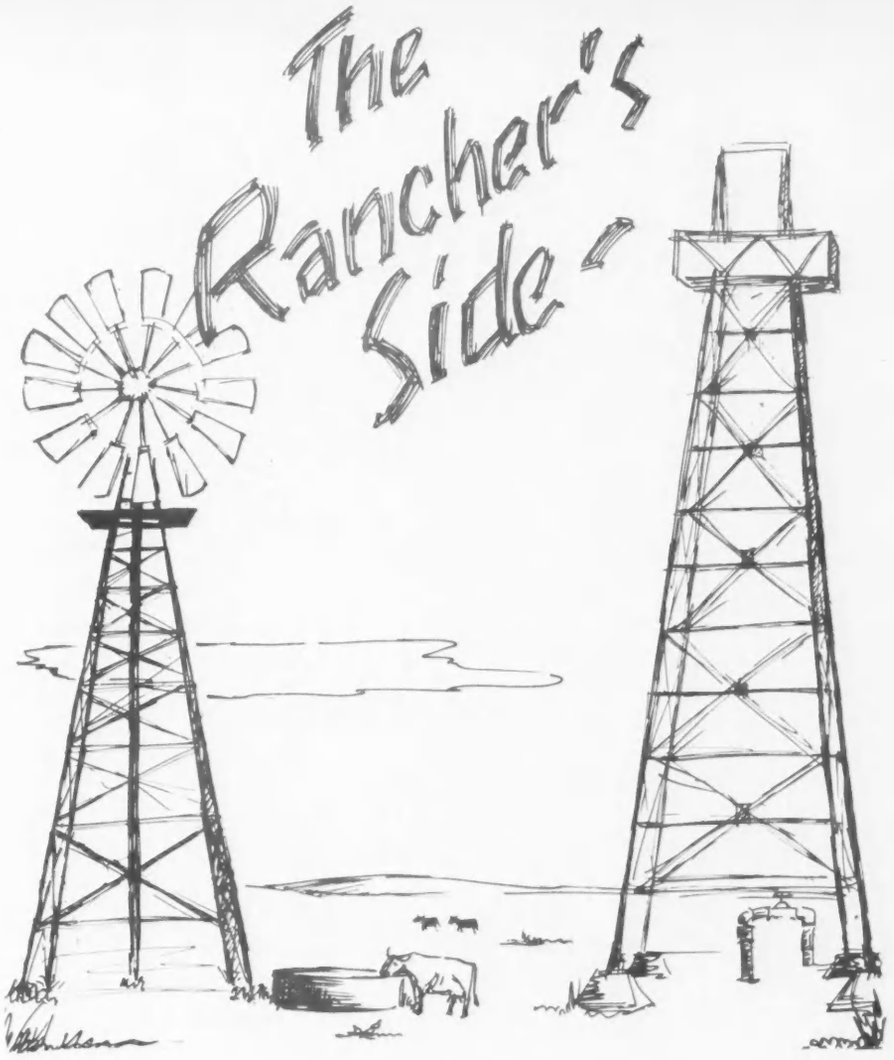
Oklahoma also played an important part in the overall gain by increasing its activity 59.2 percent during January. Kansas' wells were up 14.6 percent and California showed a hike of 17.2 percent.

Louisiana's total wells failed by 16.3 percent of matching those of a year before, and Indiana's and Illinois' were off 48.5 and 1.7, respectively.

Well Completions in the United States During January, 1951

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from the Producers Monthly)

STATE or DISTRICT	MONTHLY COMPLETIONS—Details for January, 1951									Total Completions			Percent Difference From Year Ago	TOTAL FOOTAGE		Rigs in Operation (Drilling, Rigging Up and Shut Down)		
	NEW WELLS																	
	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	Jan., 1951	Dec., 1950	Jan., 1950		January, 1951	January, 1950	Jan. 31, 1951	Dec. 31, 1950	Jan. 31, 1950
Alabama	3			4				7		7	5	3	+133.3	30,969	13,996	6	8	3
Arizona				1				1		1				3,640		3	3	4
Arkansas	22			12				34		34	41	31	+ 9.7	117,227	100,926	27	30	22
California	81		1	99			2	183	15	198	175	169	+ 17.2	710,368	787,245	206	207	257
Colorado	5		1	11				17		17	16	7	+142.9	71,478	19,275	18	25	4
Florida												1	—100.0		11,576	1	1	4
Georgia												1	—100.0		5,265			
Idaho																1	1	2
Illinois	86		1	86				173		173	271	176	— 1.7	444,088	398,014	189	246	181
Indiana	18		1	33				52		52	69	101	— 48.5	100,692	191,716	190	217	123
Kansas	160		16	120			2	298		298	405	260	+ 14.6	1,007,092	892,246	340	337	299
Kentucky	36		19	35	1			91		91	99	60	+ 51.6	175,527	126,689	92	104	84
Louisiana	98	13	12	72				195	1	196	202	234	— 16.3	1,383,838	1,488,639	217	235	236
North Louisiana	43	6	8	28				85	1	86	110	112	— 23.2	337,503	440,048	64	78	69
South Louisiana	55	7	4	44				110		110	92	122	— 9.8	1,046,335	1,048,591	153	157	167
Maryland			2					2		2				7,275		6	8	
Michigan	18		2	20				40		40	49	67	— 40.3	97,941	160,763	110	120	133
Mississippi	8	3		12				23		23	23	34	— 32.4	158,128	252,356	26	27	25
Missouri												4	—100.0		1,824	5	6	7
Montana	15			3				18	1	19	14	9	+111.1	43,386	22,306	29	34	17
Nebraska	6		1	3				10		10	10	5	+100.0	43,108	21,945	11	9	8
Nevada																2	1	
New Mexico	23		20	15				58	1	59	41	58	+ 1.7	275,856	249,141	113	108	90
New York	20				14			34		34	36	70	— 51.4	47,026	96,662	72	75	101
North Dakota											3					1	2	
Ohio	34		19	28				81	5	86	68	62	+ 38.7	178,177	139,676	126	140	174
Oklahoma	331	3	29	231	3		6	603	18	621	359	390	+ 59.2	2,309,575	1,367,172	563	682	534
Oregon																	1	
Pennsylvania	34		27	11	29	8		109	2	111	107	117	— 5.1	206,378	210,841	205	243	230
South Dakota											1	1	—100.0		5,710			
Tennessee												1	—100.0		1,430	7	8	11
Texas	891	20	114	510		1		1,536	33	1,569	1,407	1,408	+ 11.4	6,396,735	5,968,414	1,403	1,485	1,314
Dist. 1—South Central	35			27				62	2	64	41	38	+ 68.4	159,874	96,841	38	35	34
Dist. 2—Middle Gulf	24	4	19	31				78	1	79	51	39	+102.6	447,816	224,759	45	57	40
Dist. 3—Upper Gulf	82	5	14	37		1		139	1	140	164	128	+ 9.4	774,060	697,224	138	149	113
Dist. 4—Lower Gulf-S.W.	79	8	9	41				137		137	133	146	— 6.2	662,038	665,710	113	110	100
Dist. 5—East Central	11		1	16				28		28	19	13	+115.4	81,601	64,794	38	29	17
Dist. 6—Northeast	40	2	5	11				58		58	83	74	— 21.6	295,577	326,619	43	50	34
Dist. 7-B—North Central	96		3	104				203	5	208	213	152	+ 36.8	549,623	462,108	168	144	159
Dist. 7-C—West Central	66	1		40				107	7	114	82	77	+ 48.1	443,223	352,512	133	109	88
Dist. 8—West	287		2	61				350	16	366	315	375	— 2.4	1,923,469	2,001,399	439	459	453
Dist. 9—North	125		2	127				254	1	255	234	275	— 7.3	693,825	798,397	158	236	174
Dist. 10—Panhandle	46		59	15				120		120	72	91	+ 31.9	365,629	278,051	90	107	102
Utah				2				2		2	3	3	— 33.3	4,939	10,383	12	11	5
Virginia																1	1	1
Washington																		1
West Virginia	8		50	13				71	3	74	38	56	+ 32.1	216,521	151,928	210	205	250
Wyoming	34		1	12				47	2	49	52	49		227,332	245,975	83	85	60
Total United States	1,931	39	316	1,333	47	9	10	3,685	81	3,766	3,494	3,377	+ 11.5	14,257,296	12,942,113	4,275	4,665	4,180



FOREWORD

THE following, as the title indicates, is the rancher's side of a problem that exists and sometimes ends in dispute between the landholder on the one side and the oil and gas companies on the other.

The problem is one of relations between rancher and oil man insofar as development of the oil industry on their lands is concerned.

This little piece came about as the result of some serious consideration on the part of a group of West Texas ranchers who have had the usual difficulties that sometimes ended in squabbles over surface damages, pipe line rights-of-way, damages to livestock, etc.

It is their idea that much of the misunderstanding and, in some cases hostility, between rancher and oil man over surface property rights and damages that are not only unpleasant for both parties but are often unnecessarily expensive to both sides and sometimes end in court can, in a large measure, be eliminated through a better understanding and consequent consideration beforehand.

With that idea in mind, a group of West Texas ranchers in the Permian Basin presents "their side."

To you who might not be too well acquainted with the history of the Permian Basin area of West Texas as far as what lies on top is concerned, we might mention beforehand that before the relatively recent discovery of oil out here it was quite a problem to scratch a living out of the ground—or for our cows to—and to make the next payment on the mortgage. We, like people everywhere, are creatures of our environment. The land we now own we got the hard way—most of us.

This article is published through the courtesy of J. N. McKean, public relations counsel, Midland, Texas

THE story that the Dollarhide oil pool got its name from the fact that during one of the bad years the hide off a dead cow was worth more, one dollar, than a live cow on the hoof isn't quite true. The field was named for a rancher by the name of Dollarhide. But it is true that during some years of drouth ranchers got more from the sale of hides off cows that died than from the sale of live cows.

But in spite of the lean years, the sandstorms, the summer heat and the drouths, we gained quite an attachment to this land, however it may look to you. Our sons and daughters inherited this attachment and intend to stay here and live on the land.

A stranger was always welcome at a ranch house and usually stayed for dinner. The reputation of hospitality West Texas ranchers earned was genuine, but something

has happened and we don't feel quite as hospitable as we did. Frankly, we are worried about our reputation.

And now the next chapter which may be harder for you to understand. Along came oil and most of us—not all of us—benefitted materially from oil development.

We know what you are thinking: "Well, what the hell? You've got more money than you ever had in your life. All you have to do is sit back and wait for the next royalty check and here you are beefing about a little oil squirted around over those dry sandhills or a little scraping around for a new location, roads, a pipe line or caliche pit."

We know that some of you who live up in Tulsa, New York, Fort Worth, Dallas or Houston think we are a bunch of "high binders" and we are probably a little hard-headed. We have our own ideas about what's ours and what's right.

While we are certainly grateful to the oil companies for what they have done for us and this country, we intend to preserve this land of ours and develop it for ranching right along with your development of the oil resources.

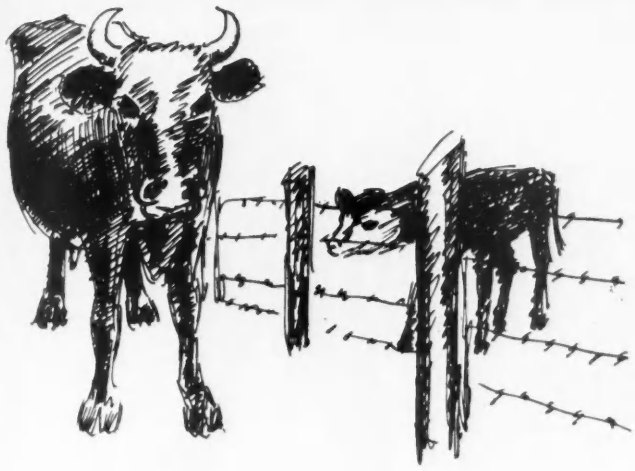
Right here we might make a little sidelight observation. We still maintain what might be called a peculiar status in the world today. We are individualists—rugged, if you like—and we intend to be individualists right up till the collectivists divide up our cows among themselves—over our dead bodies with boots on.

We hate to see anything wasted, especially our land, no matter how poor it looks. And we don't like to be kicked around and told what we have to do by the government, oil companies, or anyone else. We often times are called for jury duty and we notice in serving on oil company cases that you have much the same idea about your rights as we have about ours. You apparently believe as strongly in free enterprise and property rights as we do.

We know, of course, that an oil lease is binding on both parties. Part of that contract, we believe, involves an obligation on the part of the oil company to exert reasonable care in the use of our land for oil development. We know there have been abuses of contract obligations by both sides and we know, too, that you have some of the finest men in the world out here representing you. As a matter of fact, some of you have leaned over backward to maintain friendly relations and help us carry on ranching right along with your oil development. Most of you believe in conservation, the same as we do. However, some of your representatives who seem to have less concern for our rights, or at least are careless and thoughtless in their acts, have caused dissension between rancher and oil man. Following are some of our complaints:

Fences and Gates

Left-down or open gates and broken fences have undoubtedly ended more beautiful rancher-oil man friendships than any one other act. This comes under the head of the unforgivable sin. And if you had to ride over 40-some-odd sections of mesquite, catclaw and greasewood



lookin' fer them critters you'd know why. Sometimes they're not found until the next roundup when they turn up in a neighbor's pen. If they haven't been branded, no one knows whose they are.

Several years ago a company disburser blew his top when he got a statement for $25 for one cow's teat—tit to you—that had gone sour. And the company superintendent had OK'd the bill. Much correspondence followed to explain the strange episode during a construction job. A contractor's employe had left a gate open and by the time a company truck driver came along and closed the gate, mama cow's calf was on one side of the fence and she was on the other. Several days later the rancher found the calf almost starved to death and one of mama's tits swelled up and gone sour.

Roads and Pits

You might think us ranchers would be happy that someone should come in and build us some nice caliche roads to get around on—but we ain't always. About all the traveling we have to do on ranch roads is around the windmill circuit for inspections and repairs and to haul salt. Otherwise we ride horseback. And every new road

is another invitation for more traffic on the ranch. We can't very well keep people from coming in on private oil company roads, especially when there are so damn many roads. We wonder sometimes if you couldn't have used our road—even if it does wind around a little—instead of building another almost parallel to it.

The more roads you build, the more grass land we lose, and cattle hide out from traffic.

Few companies would open a caliche pit without permission from the landholder. But some of the contractors have fewer scruples about such. Often the rancher already has a pit open somewhere or can advise the company or contractor where and under what terms they may get road-building material. How would you like to have a hole 20 feet deep and a 100 feet across dug in your yard?

Drill Sites

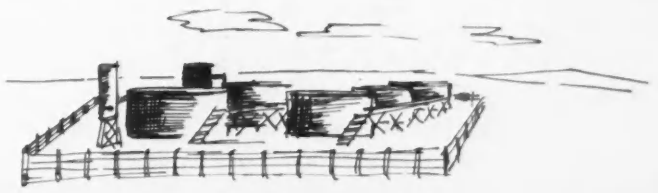
Some of the drilling rigs are operated like clocks and

some like an East Texas sawmill. Some of the things we don't like about a drilling rig operation are:

- Too many roads. Too much land cut up.
- Scrap and junk thrown around that cows cut and scratch themselves on.
- Blown off oil that kills vegetation.
- The cleanup job after completion.

Permanent Installations

Some of the wells, tank batteries, plants and other in-



stallations are better than we could ask for. Most of the companies fence their tank batteries and blowoff pits and keep them in fine shape. The use of an ell and a nipple that will direct spray downward on any blowoff will usually save several acres from oil soaking, especially when

the wind is blowing which it usually is. And a little junk pipe and a few feet of barb wire built into an enclosure around a pipe line drip blowoff into a pit will save us not only a few acres of grass but maybe a cow or two a year. After a rain when there's a little oil on top of the water in a pit, the old cow comes along, takes a drink, and usually blows her guts out.

And, of course, we would like to have slush pits filled in so we don't drive over them a year or so later and sink up to the hubs.

Old sheet metal, any kind of scrap thrown around, offers a cow a handy way to scratch or cut herself and from there the flies take over. When we find that cow, we've got a hide full of worms. Maybe you've never seen worms work on a cow, but they sure work fast.

Pipe thread protectors that are thrown around also cause trouble. Cows step in the darn things and first thing we know, the protectors have worked up on their hoofs or legs, their feet or legs have swelled up, and we have a helluva time getting the things off.

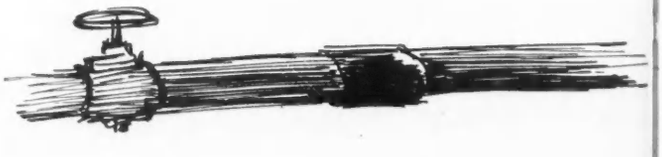
Several cows don't get to market each year because of fast driving on lease roads.

Cows are dumb critters. Almost as bad as the lady who got her tit caught in the wringer, a cow got her head caught in a pump jack and had to be killed.

Pipe Lines

Pipe lines, we have decided, are a necessary evil. Our chief complaints, again, have to do with fences, gates and all the unnecessary damage to our land and livestock that results. Pipe-liners don't seem to realize the importance to us of some of these things and especially the care of our livestock. Just because a big herd of cattle is not in sight doesn't mean there are no cows around. Most cows out here are wild and the more chousing around they get, the less we get for them when they go to market. Often they won't go to water when construction or pipe line crews are around and sometimes can't on account of pipe strung around or an open ditch.

What little vegetation we have on this dry land is highly valuable to us. Once it is scraped off, there's nothing to hold the ground down when the spring blows



start. And with the average rainfall what it is—or ain't—that grass is a long time coming back. Thoroughbred cattle that many of us raise for breeding purposes offer another problem. A carelessly left-open gate often results in a scrub bull getting in with our registered cows and the

loss of thousands of dollars worth of thoroughbred calves we *don't* get.

And, of course, a pipe line right-of-way grant is "not for just a day" but is from now on and is, figuratively speaking, an opening into the bathroom to last forever. But we are paid only for the first entrance.

Hunting and Trespassing

Until oil development out here, we weren't bothered with swarms of people on our ranches. Up until the exploration crews followed by the drillers, the production people, the pipe-liners, the plant and camp builders and all the multitude of contractors and supply and equipment salesmen who follow in the wake of oil discovery made our ranches their domain, our property rights meant something. No one except cattle rustlers thought of going on one of our ranches without permission. Even though a lease contract includes the right of entry for development, it isn't a blanket agreement for trespassing and hunting rights for an oil company's employes nor for all of an oil company's brothers, uncles, cousins and other figurative kinfolks.

Many of them seem to think the covey of quail they spot is theirs for the shooting or the windmill tank on the backside of the ranch—just off an oil company road—is a fine place for a Sunday picnic or target practice with their .22's.

Of course, your board of directors didn't authorize their presence, but there they are. They resent the fact that we ask them to leave so the cattle will come to water.

Some of your young men are apparently out of the city and in the open for the first time and act plumb trigger happy. A ranch seems to be an open invitation to shoot anything that moves and they don't always confine their shooting to jackrabbits. Windmills and even cows seem to offer inviting targets. Locked gates are no barriers. If they can't break the hinges off, they shoot the lock off. Or sometimes in jeeps they just drive right over the fence and leave it down.

Most West Texas ranches cover quite a bit of territory, and we don't have a police force riding around to keep people off. But we do have a traffic problem.

Leased land is another worry. In some cases, especially University of Texas lands, the surface is leased to the rancher and mineral rights to the oil companies. Usually, the rancher is held to strict account for the surface, and many leases can be canceled for violation of terms of the contract.

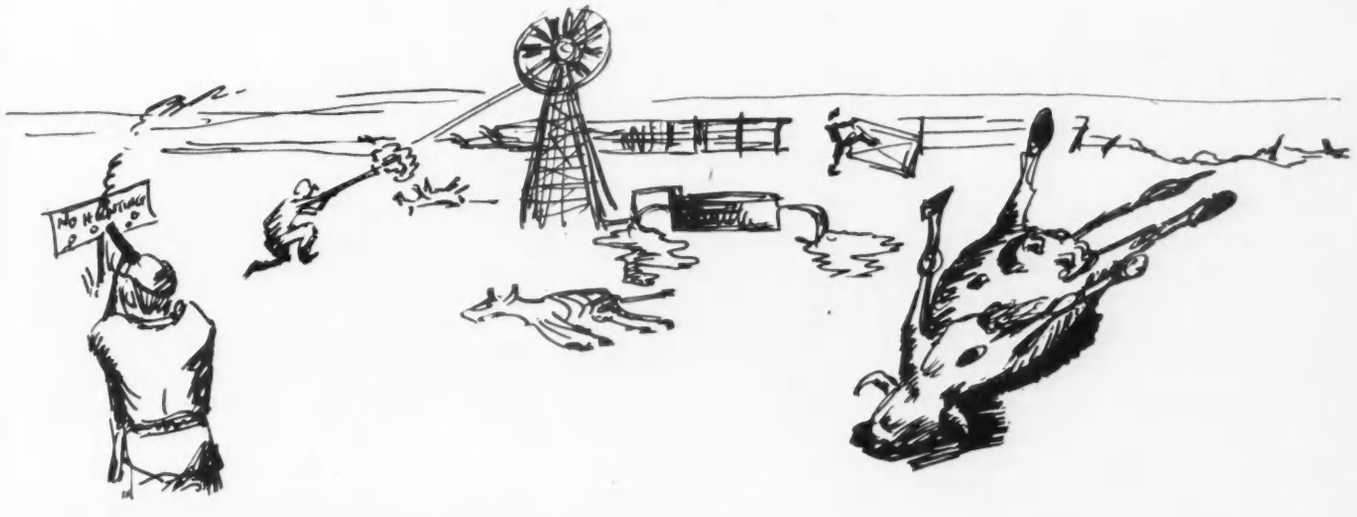
Roundup

In summing up the situation we might put it this way:

- We, like you, don't like the idea of being forced to do anything. The forceful entry of right-of-way through our property is in itself distasteful.
- A right-of-way grant is "not for just a day" but forever and the amount received for the right-of-way has to compensate for a continuing situation of entry onto and through our private property that actually makes ranching difficult and results in a real loss and continuing damage.
- Thoughtless and careless acts rather than the willful act of company representatives and others who are on our land by reason of the company operation cause most of the damage. And the damage usually varies directly with the individual. Some of your men are invaluable to us in preventing damage and waste, but others display little conception of our problems or regard for our rights.
- Most of us participate in soil and range conservation programs for the improvement of our land and on which many tax dollars are spent. We hate to see the results nullified by carelessness that may cause the spending of more tax dollars.

Yep! We have our side and we know you have yours, too. Somewhere there's the happy middle ground and the ranchers are willing to go their part of the way.

We can't ask you out for Sunday dinner—we're all too far removed—but we hope you'll read this and join us in hunting the proper middle ground, the ground on which we all may be friends.



Better Bosses - - -

The HUMBLE Way

By AL REESE
Managing Editor

"Management is the development of people, not the direction of things."

Humble Oil & Refining Company and Humble Pipe Line Company could aptly have made that the theme of a humanized management and supervisory training program now being conducted on a scope rarely surpassed by a firm of comparable proportions.

Officials from all levels up to the board of directors are learning to do better jobs through conferences and training sessions of a week to two weeks' duration.

In essence, the program borrows the best from other training plans, adding new ideas advanced by Humble men. In practice, it offers a refreshing approach to a problem shared by every growing organization—that there is a constant need for more leadership through every strata of employes. A company head who 20 years ago was separated in space and spirit from his employes by no more than the thin partition between plant and office may now find himself marooned in the penthouse of a towering business edifice, remote as Mars from those in the complex maze below.

The answer is obvious: more efficient leadership through every employment level—leadership sympathetic with both the aims of management and the problems of the employes they lead.

Less obvious is how to obtain this more efficient leadership, and it is here that Humble's method makes its first departure from the ordinary. One procedure would have been for management to adopt a plan and order the Training Division to put it into effect. The Humble way was to draft a plan in anticipation of a request for it, thereby recognizing the wisdom of the old saw, "You can lead a horse to water but you can't make him drink,"

HUMBLE OFFICIALS of all levels up to the board of directors are participating in a training program that promises lasting results. The plan has a number of distinctive features, one of the most noteworthy being that it was instituted at the request of the employes and was not handed down upon instructions of management.

and improving it with this addendum: ". . . unless he's thirsty."

First to get thirsty were Humble Pipe Line Company workers at Midland. In 1948—a year after the plan had been drafted—the Training Division was asked by the West Texas Division to suggest a medium for developing supervisors. Five weeks later, a program of conferences was given a trial run at Midland. Word spread, and they were repeated at McCamey and Odessa. Thereafter they were held at monthly intervals over a one-year period in the West Texas Division of Humble Pipe Line Company.

Concentric circles of interest washed through the Humble organization and demand for the plan was now assured; but it remained to tailor it to the needs of all. Obviously, the same training would not benefit a production foreman in Florida and a sales executive in Houston. This considerable task took on enormity when it was decided to offer training to Humble's entire management group.

The result was two programs, Administrative Management and Fundamentals of Supervision.

The course in Administrative Management consumes a week and embraces all employes from the level of assistant district superintendents up to the board of directors. The men meet in groups of 18 to 20, all selected from different areas of operations by Humble executives. Members of top management take part. President Hines H. Baker, Chairman L. T. Barrow, all members of the Board of Directors, and others have talked on such topics as relations with employes, stockholders, the public, and the government.

Conferences are held on the concepts and functions of the job of managing. These concepts, as Humble sees them, are three-fold: (1) management must be based on sound principles; (2) management must be conscious of the effects of its decisions and actions on others; and (3) it must be cost-conscious. Functions of Administrative Management are defined as forecasting, planning, organizing, coordinating, directing and controlling. Case histories are introduced. A theoretical case is set up and the conferees tell what they would have done under the same conditions—and why. Ideas are exchanged, policies clarified, divergencies of opinion aired.

Much stress is placed on the need for good human relations. There are discussions on successful supervision, what employes want, improving personnel management and conducting meetings. The sessions close with this challenge: Humble was built by sound management. The job of present management is to maintain and improve the company's record by applying sound management principles and by practicing good human relations.

Another major departure from the accepted training pattern was made in designing the course in Fundamentals of Supervision. Here was a different problem. The course in Administrative Management had been taken by a comparative few, all experienced in leadership.

The Fundamentals of Supervision trainees would be more numerous

(2800 will have taken the course by the end of 1951) and in some cases their experience in leadership would be sketchy.

And there was still another problem—delicate, touchy. Officials in the Administrative Management course had all been a part of management's medium and upper brackets. They were acquainted with its problems, sympathetic with its goals. By contrast, some who would take the course in Fundamentals of Supervision had only a hazy idea of management's ideas and ideals. How to win their complete enthusiasm? How to scotch the notion that they were being fed a sugar-coated pill that would cure no ailments except those of top management?

The solution was contained in a single word: Decentralization.

As it works, committees choose men from California to Florida who will learn the fundamentals of supervision and then teach them in that particular area. Men from every phase of operations are included to assure a representative group—such men as division petroleum and civil engineers, division geologists, district superintendents for production and pipe line, and assistant division sales managers. In all, 63 have been selected to be groomed for their important tasks.

Brought to Houston in three groups, the "teachers-to-be" attend an intensive two-weeks' course. First they study conference leadership. Then comes the Training Division's presentation of the material to be used in Fundamentals of Supervision conferences throughout the areas of Humble operations. Finally, they are called upon to exercise what they have learned by actually teaching some other trainees to do the job, always under the supervision and guidance of someone from the Training Division.

Upon concluding the course, the leaders return home and the supervisory sessions begin in Humble's division headquarters at Houston, Baytown, Tyler, Midland, Corpus Christi, Abilene and New Orleans. The conferences will be held as often as there are enough new supervisors to make up a group of 15 to 20 men.

Conference Procedure

Each week's course of conferences is opened by a division manager in the area with a welcome and remarks on the need for effective supervision. Then the conference leader takes over and traces the company's origin and development. No hurried sketch, this is a complete history of the company, loaded with information on the men and policies responsible for Humble's growth.

Then, by turns, the group takes up Organizational Structure and the Supervisory Team, The Job of Being a Supervisor, Tools of the Supervisor, Job Relations, New Employe Induction, Job Instruction, Effective Discipline, Planning, Directing, Grievances, Summary of Human Relations, and Economics and the Corporation Employe.

Several lively hours are devoted to the elements of job instruction—defined simply as "teaching a man to do a job." Each member of the conference takes his turn at teaching another, and with the aid of some well-executed showmanship, the point is driven home that showing or telling a man how to do something is not enough—it takes a combination of both to get good results.

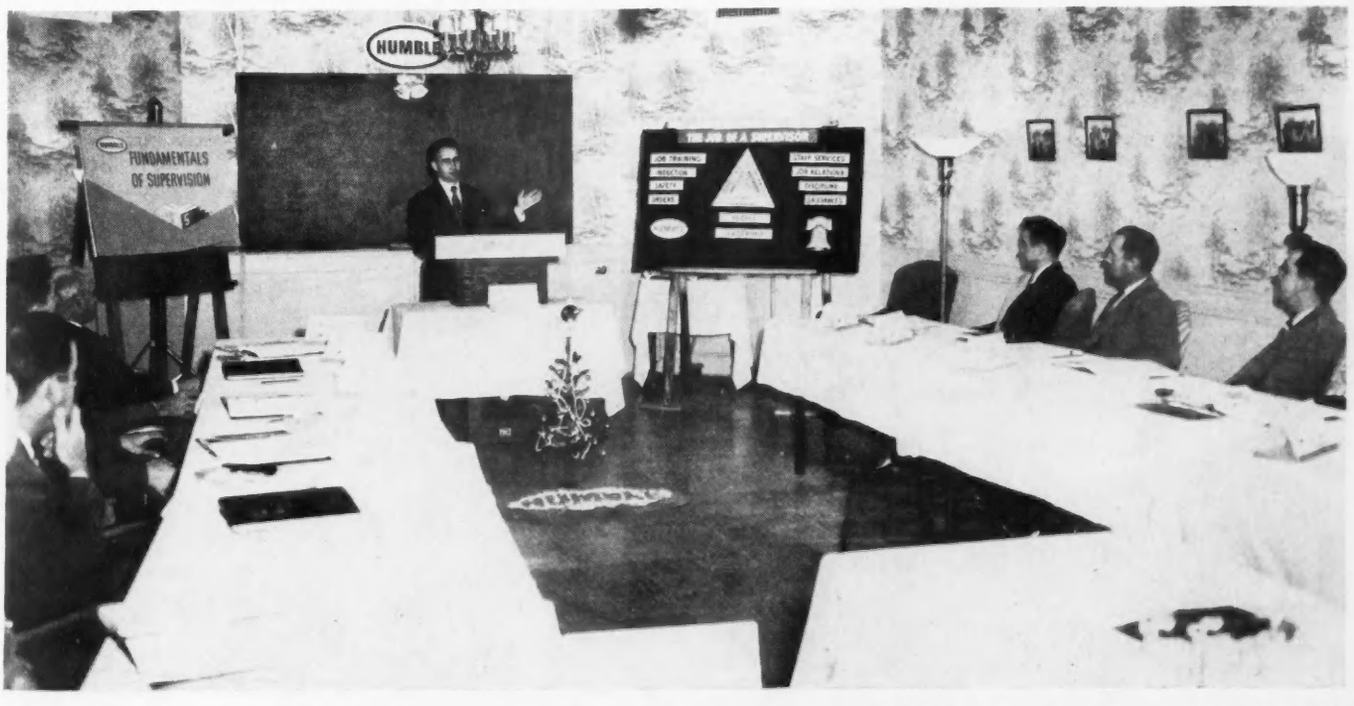
Several guest speakers during the week discuss safety, good public relations, fundamentals of economics, and Humble's Annuities and Benefits plans. Questions-and-answers periods follow each special talk.

The conferences are closed, as they were opened, on the fifth day by a member of division management. Each member in attendance receives a certificate in recognition of his week's work.

Success of the program can be measured by two revealing comments:

From an Administrative Management Conferee—"Major benefit arises out of taking time to think definitely about management problems and to share experience with others."

From a Fundamentals of Supervision Trainee—"I didn't think there was anything in the world that could sit me down for six hours a day, five days straight, and keep my interest. But, brother, this course took hold of my interest and wouldn't let go. You know why? All this material was talking about *me,* about things *I* can use. It's going to help me be a better supervisor."



This conference setup is typical. Good lighting and equipment are provided. Visual aids help drive points home. The rug on the floor bears the Humble emblem, was made for the conferees by Mrs. Edward J. Herr, wife of the district gauger, Cisco district, on the Bateman lease.

a CARDWELL "MOBILHOIST"... for

OPERATING PROFITS! That's why this Cardwell "Mobilhoist" is the largest selling, self-propelled servicing rig in the world.

You can do a wide variety of rod and tubing, reverse circulation, rotary and cable tool workover jobs with only one "Mobilhoist." It's big enough for 5,000-foot well servicing and fast enough to service shallow wells at a profit. A rotary drive is installed for 1,500-foot rotary drilling, or 5,000-foot rotary workover jobs. A spudder is installed for well deepening, "drilling in" and other cable tool workover jobs to 4,000 feet.

Within its depth capacity, the Cardwell "Mobilhoist" can give you 'round the clock operation and year after year profits. Write for a "Mobilhoist" catalog and the name of your nearest Cardwell representative.

Cardwell rigs are sold direct from factory to user. That's why they are the lowest price with the highest quality. Factory-owned parts stocks are maintained all over the world.

IT'S A SINGLE-PACKAGE RIG — FAST ON THE ROAD OR IN THE FIELD — QUICK RIG-UP WITH FEW MINUTES FOR TEAR DOWN.

'round the clock profits!

PULLING RODS AND TUBING

"DRILLING-IN" WITH CABLE TOOLS

ROTARY WORKOVER JOB

CARDWELL

REG. U. S. TRADE MARK PAT. OFFICE

THIS TRADE MARK INSURES HIGHEST QUALITY AT LOWEST PRICE

CARDWELL MFG. CO. INC.

P. O. Drawer 2001 . . . Long Distance Telephones 128—129—130

Cable Address: "ALL STEEL," Wichita—"CARDSTEEL," New York

Wichita, Kansas, U.S.A.

Factors Involved in Forming

Spacing Units

By C. B. CARUTHERS
Unitization Superintendent
Stanolind Oil and Gas Company, Tulsa

USUAL STEPS taken in forming a drilling unit are discussed by the author. The discussion is directed especially toward company land men, who deal with landowners and operators in connection with unitization problems relating to drilling units. The subject is treated from the layman's rather than the legal point of view.

THE fundamental purposes of any unit of oil and gas properties are to conserve oil, gas and associated hydrocarbons, to protect correlative rights of the owners of these products to the end that each receives the fair share to which he is entitled, and to effect economy of operations consistent with the foregoing purposes. Formation of a unit can be justified only to the extent that it accomplishes all of these purposes. If unit operations do not promote conservation and increase ultimate recovery incident to such conservation, they will not meet with the favor of state conservation authorities. If correlative rights of any owners, and particularly land owners, are adversely affected by unit operations, the parties who formed the unit may be faced with litigation brought by such owners or by governmental bodies under antitrust laws. If a unit operation accomplishes conservation and protects owner's rights, but is economically unsound, it is in the same category as the surgical operation which was a complete success but following which the patient died.

The following article will discuss unitization of oil properties with particular reference to drilling and spacing units. It is the intention of the author to direct the discussion towards company landmen who are on the firing line in dealing with landowners and operators in connection with unitization problems relating to drilling units. The subject will be approached from the layman's, rather than the legal point of view, confining discussion mainly to various considerations and steps entering into the formation of drilling units.

To begin with, a clear understanding should be had as to what comprises a unitization of oil and gas properties. One rather broad definition of a unit operation is the pooling or combining, for operating purposes, of the working interest and royalty interests in the production from a common source of supply underlying separately owned tracts of land. An operating arrangement between operators concerning their working interests only, which does not involve the pooling of royalty interests under separately owned tracts or leases, does not constitute a unit in the true sense of the word. The term "unit" as used here will refer to a complete unitization of both royalty and working interests unless otherwise qualified.

Fieldwide units and drilling or spacing units have the same basic purposes, the main difference being one of scope or the number of properties involved. The ideal arrangement is, of course, a fieldwide or complete reservoir type of unit which is formed as soon as possible after a discovery well is drilled. In such a unit, wells may be drilled at advantageous locations based on sound engineering practices and knowledge of reservoir characteristics and without regard to lease lines within the field. The effect of this is to permit a common source of supply to be exploited as an entirety and to concentrate drilling of wells at desirable points for obtaining maximum production. Also, in a fieldwide unit, secondary recovery methods such as gas and water injection programs may be undertaken which in most instances could not be attempted without unitization to protect the correlative rights of mineral owners.

When the mineral ownership in a field is diversified, formation of a fieldwide unit is usually most difficult because of differences of opinion between owners as to fair bases of participation in unit production, the proper unit boundaries, and other controversial factors. Since time is a vital consideration in starting the operation of a fieldwide unit, extended negotiations by operators attempting to form such a unit may defeat the purposes for which it was initiated. In mind are certain fieldwide projects which have been in the negotiating stage for several years, and much of the benefit of unit operation which would have resulted from the secondary recovery programs contemplated has already been lost through dissipation of gas reserves and pressures.

Where formation of fieldwide units cannot be accomplished before development is completed, it usually becomes necessary or desirable to proceed with development under drilling or spacing units outlined to conform to an established spacing pattern. When one lease covers one or more spacing units, pooling of ownership interests thereunder is unnecessary. Where small or irregular tracts comprise a drilling or spacing unit, or diverse mineral ownerships are involved, it is desirable to unitize such ownerships to form the unit. Subsequent discussion of this subject will be mainly concerned with such drilling units.

State regulatory bodies are fairly uniform in defining drilling units. For example, Mississippi House Bill No. 80 contains the definition: " 'Drainage Unit' or 'Drilling Unit' shall mean the maximum area in a pool which may be drained efficiently by one well so as to produce the reasonable maximum recoverable oil or gas in such area." Similarly, the Louisiana Oil and Gas Conservation Law, Act 157 of 1940, states: "A drilling unit, as contemplated herein, means the maximum area which may be efficiently and economically drained by one well, and such unit shall constitute a developed area as long as a well is located thereon which is capable of producing oil or gas in paying quantities."

The size of drilling or spacing units in a given field is usually prescribed by field rules issued by a state conservation body after a thorough review of available data obtained on wells drilled and after public hearings thereon, although in some instances field spacing patterns for drilling units have been established by operators in the absence of field rules in accordance with terms

Thinking of Speeding up Development?

Producers of oil and natural gas are invited to consult with our Oil Department for aid in financing *accelerated development drilling programs.*

All inquiries on petroleum and related matters will receive prompt attention.

Empire Trust Company

NEW YORK

Downtown Office:
120 BROADWAY
Equitable Building

Uptown Office:
7 W. 51st STREET
at Rockefeller Center

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

of their leases. Factors usually taken into consideration by a conservation body in establishing rules for a field are depth of wells, character of the reservoir, probable drainage area for a well in the formation involved, the cost of a well, and available market outlets in the case of gas fields. Such rules are subject to later modification to correct initially established productive limits of a field, to alter size of units, or to correct any inequities which may have been proven to exist after further development of the field.

In certain states, notably Louisiana and Oklahoma, some conservation orders covering a specific field and reservoir have the effect of unitizing mineral ownerships in the units. Such orders not only stipulate the appropriate size of drilling units but further designate the particular tracts of land which will comprise the respective drilling units and place a limitation of 1 well per unit. This well limitation is supported by statutory provisions requiring a distribution of proceeds from a drilling unit to all the owners of separate tracts within the unit, thus insuring land owners a fair share of production attributable to their land.

In other states, and notably Texas, the size of units is usually stipulated (with certain tolerances) without designation of specific tracts of land to comprise particular units and without limitations as to number of wells per unit. Such units do not effect any unitization of mineral interests. A limitation of wells per unit is usually effectively accomplished, however, by making acreage a factor in the establishment of well allowables and thus making it impractical to drill additional wells on individual small tracts of land not committed to units. In establishing field spacing rules, experience has shown that state regulatory bodies have acted objectively on the best information available to them, with due consideration to conservation of natural resources and with particular concern for the protection of landowners' rights.

Drilling units which conform in size to established field rules are on a firm footing with respect to considerations of correlative rights of mineral owners and conservation purposes. Units which exceed the size of drilling units required by established field rules and at the same time do not embrace the entire reservoir for a conservation or secondary recovery purpose, may be subject to challenge as to whether their formation is justified.

Let us consider the case of a large oil company with a number of small undeveloped leases in a particular field. Let us assume that the ownership in the field is diversified and no fieldwide unit has been proposed or considered feasible; that a number of company leases are nearing their expiration dates; that royalty owners are making development demands, and that the company wishes to start a drilling campaign in the field. Under such conditions landmen will check field maps and plan a disposition of leases to be recommended to management. The recommendation will no doubt include the unitization of certain small tracts to form drilling units subject to the following considerations:

(a) Have field rules or spacing orders been issued which will govern the size of spacing units which can be formed in the field, or which stipulate the tracts of land to be included therein? If so, what specific formations, type of production (oil, gas or both) or tracts are covered by the rules or orders?

(b) Do leases have pooling clauses which authorize inclusion of the lands covered in the kind of drilling units contemplated?

(c) Is a state spacing order in effect which can be relied on as authority for forced pooling in the absence of adequate pooling clauses in the leases?

(d) What is the depth of wells contemplated for the proposed units and are firm commitments to drill or participate in such wells to be made in proposing such units to other interested parties?

(e) Are the units to cover oil, gas or both? If both, consideration should be given to any difference in the size of units provided by separate spacing rules which may be in effect for separate oil or gas reservoirs.

(f) Do other operators own tracts of land within contemplated units and if so who are they and what are their ownership interests?

(g) What basis of participation is to be recommended to the tract owners in the unit? (Generally a straight acreage basis will be used in drilling units because of their small size; however, acre feet of productive sand or other basis may be feasible.)

(h) What party should be selected as unit operator of each unit?

(i) Can the land in leases to be included in a unit be identified from the description in the leases or will it be necessary to have a survey made for this purpose? (It may be desirable to attach a plat of the lands pooled to unit agreements for identification purposes, when lease descriptions are inadequate.)

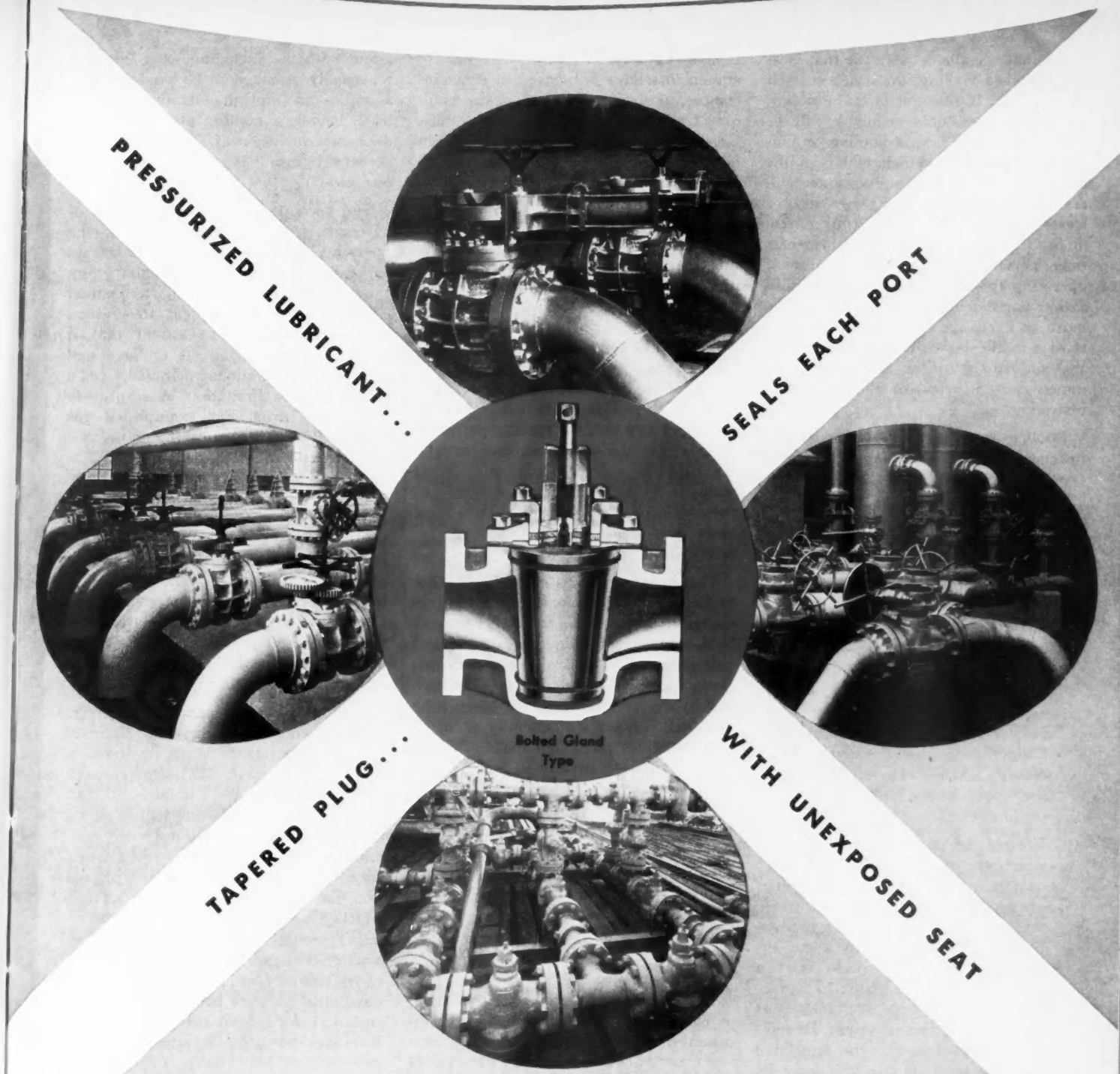
(j) What are the economics of each proposed unit, i.e., the estimated cost of a test well in the projected formation, the estimated total recoverable production, the estimated value of recoverable production, the estimated payout period for investment costs (taking proration allowable and income taxes into consideration?)

(k) What name will the operator use to designate a proposed unit? (Since the records of the various unit participants as well as those of state conservation bodies must identify the property in question, it is desirable to assign a name to the unit at the time it is proposed. This will facilitate future handling of billings, governmental reports, correspondence, etc.)

Most of the foregoing data will be readily available at the outset, but some of it will have to be determined. Having obtained all or as much of the foregoing information as possible, landmen are at least in a position to recommend an intelligent program to their principals or proceed on their own if representing their own interests. It is hardly sufficient to simply recommend to management that a unit be formed of section so and so and that a test well be drilled thereon, without naming the leases, the unit participants and other relevant data. However, it is surprising the number of drilling units which apparently are started in just this manner. Most major companies will require the foregoing data before approving such a program, and time will be saved in initiating and carrying out the program if a proper analysis and presentation of all available and pertinent facts is made at the outset.

Having mapped out the program and received approval, the landman is now ready to proceed with unitization. Taking a particular unit to begin with, the next step will be to approach other operators who own tracts therein, if they have not already been approached. These operators will no doubt have their own ideas about the size and shape of the unit, basis of participation, and market outlet, and will have to consider their obligations to lessors under their leases before agreeing to join the unit. If all the preliminary data already mentioned have been obtained, the position is more favorable for selling the program to the other operators. Usually other operators' consent to participate will be contingent upon the project's being covered by satisfactory unit agreements, and at this point the legal department is called upon to prepare the necessary legal instruments.

The type of unit instruments required will depend, of course, on the facts already developed, and the legal department will need to know them. If the unit is to be a forced unit, that is, one accomplished by applying for and obtaining an order from a state regulatory



Modernize your Manifolds with

Nordstrom Valves

NOW AUTOMATICALLY LUBRICATED WITH Hypermatic

TRADE MARK

PATENTS APPLIED FOR

ROCKWELL MANUFACTURING COMPANY

400 North Lexington Avenue • Pittsburgh 8, Pennsylvania

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses. Export: International Division, Rockwell Manufacturing Company, 7701 Empire State Bldg., New York 1, N. Y.

body under available statutes that permit of forced pooling, the order in itself may suffice. If the unit is to be voluntary, the agreements required will be of 2 main types; first, a pooling or unitization agreement which will pool the oil or gas rights of all the various owners under specified tracts of land or leases, and second, an operating agreement between working interest owners only pertaining to the mechanics of operating the unit created by the unitization agreements. Some companies require an exchange of assignments of interests in the leases being unitized, but the majority consider this added step unnecessary in view of the other unit instruments.

Pooling or unitization agreements may be classified as falling under 3 general types, as follows:

(a) Notices of Unitization, Declarations of Unitization, or Designations, which are executed by working interest owners only and filed of record. These instruments merely designate the unit being formed and refer to the pooling authority already contained in leases or conservation orders as the authority for such action. Individual lease amendments to grant pooling rights are usually secured as a preliminary to filing the foregoing instruments of record, when some but not all of the leases in the unit do not have pooling clauses.

(b) Formal unitization agreements; which are executed by both royalty owners and working interest owners specifying the unit being formed, the basis of allocating unit production, and containing in some instances a commitment to start a well by a certain date. In agreements of this type the conditions under which the unit may be considered effective may be stipulated and the term of the unit may be limited if desired. It may be desirable to use this type of instrument (prepared in counterparts) where all or most of the royalty owners must be contacted for pooling authority.

(c) Forced integration orders; issued by states having forced pooling laws after applications are filed for such units and open public hearings are held thereon. It is considered better practice, and in some states it is obligatory, that an effort be made to form units on a voluntary basis before application is made for forced pooling under laws permitting same. When reasonable agreements cannot be reached on a voluntary basis, owners cannot be contacted, or ownership interests are in question, it is sometimes necessary to resort to forced pooling.

Combinations of these 3 types of agreements have been used in some instances, as necessary to effect the pooling of all interests. In some cases units have been formed by pooling certain leases (under their pooling clauses) with another lease which lacks a pooling clause and drilling the unit well on the latter. In this case the well tract royalty owners are paid royalty on the well production on a lease basis and royalty owners under the other leases are paid royalty on a unit basis, i.e., they receive royalty on the portion of production which is allocable to their specific tract. This is not a true unit but for practical purposes it will perpetuate the leases from which production is being obtained and serve as a unit for spacing purposes. In this case the well tract owners who are paid on a lease basis enjoy what amounts to an overriding royalty, i.e., the excess of royalty received on a lease basis over what they would have received on a unitized basis.

The question as to the proper time to file a unit instrument of record is, to many, an open question. Some attorneys hold that the unit should be formed and unit agreements filed of record prior to commencement of drilling operations, and in any event, before the completion of a well. Leases are generally silent on this particular point, but inasmuch as a lessor's right to royalty in a lease well is different from his royalty right in the same well when it has been properly included in a unit, it would seem to follow that the category in which he falls should preferably be established before production revenues are distributed.

Altering Units

Another question that frequently arises is whether a unit once formed by declaration may be altered in shape at a later date, or whether the initial exercise of pooling authority under a lease will exhaust the lessee's right to further pooling. The particular wording of the lease pooling clause must be considered in this connection; however, the consensus appears to be that the pooling right under a standard form pooling clause may be exercised only once and that future alterations of the size of units should be accomplished only by further specific authority from royalty owners or regulatory body orders.

It is preferable, therefore, to obtain necessary pooling authority of all royalty interests involved before forming a unit and to file an instrument recognizing such unit before drilling a well. Another point that should be considered in forming a unit under lease pooling clauses is the probable productivity of the land being pooled. The exercise of good faith in including only acreage reasonably assumed to be productive in a unit is an implied obligation under a lease having a pooling clause, and the deliberate inclusion of doubtful land, or scenery, in a unit is treading on dangerous ground.

The second of the 2 main types of agreements necessary for a unit, the operating agreement, sometimes proves to be a stumbling block in completing the project. The operating agreement should conform to the separate unitization agreement to the extent that it covers the same products unitized and the same formations involved, when there is some limitation in respect to these two items. For example, if gas rights only are pooled by the unit agreement, the operating agreement should be limited to gas operations. In some operating agreements on gas units, a provision is sometimes included on the disposition to be made of an oil well. Instances have been observed where this provision consisted of only 1 or 2 sentences, and one particular case where 15 pages were devoted to the treatment to be accorded to a possible oil well in a gas unit formed in a gas-distillate reservoir.

Ordinarily, a unit operating agreement should contain some pooling language and identification of lands involved, to indicate just what is being unitized. Other essentials are the basis of participation in revenues and expenses, the designation of the operator, the commitment as to wells to be drilled, insurance to be carried, disposal of production, and a basis of making charges which is usually covered by an accounting procedure. The agreement should provide that each party will have control of its share of production, to avoid the possibility of units being classed as associations for income tax purposes under Internal Revenue Department rulings, thus making the unit participants subject to double taxation.

After an operating agreement has been reviewed and altered to meet the legal, accounting, land and operating requirements of the various unit participants, the resemblance of the initial draft to the finished document may be purely coincidental. All that now remains is to follow up to the end that each party concerned will proceed with his particular obligations under the units formed.

This article has touched upon most of the usual steps taken in forming a drilling unit. Doubtless peculiar circumstances will arise which will require new steps. At best, the forming of a unit of oil properties entails a variety of points to be decided and is a time-consuming operation. However, if the program is well planned in advance and fair to all parties, it can usually be accomplished.

Weathering

And Other Surface Shooting Problems

By NEAL CLAYTON
Century Geophysical Corporation, Tulsa

ALTHOUGH THE Poulter or surface shooting method of seismic exploration is comparatively new it is becoming widely accepted in the industry, and this article discusses some of the problems peculiar to this type of geophysical exploration. Suggestions are made for handling the weathering problem, the most difficult with which the interpreter is confronted in a program of this type.

SINCE the Poulter or surface shooting method of seismic exploration was formally presented to the oil industry two years ago, very little has been written regarding the special problems encountered in the use of this method in the field. Even less has been published regarding possible solutions for these problems. It is the writer's belief that greater acceptance of this method as an exploratory tool has been retarded largely because of failure on the part of geophysicists and others to understand that the problems are not insurmountable.

In the first place, one of two general conditions must be satisfied before the use of surface shooting is justified. It is assumed that the area selected for shooting is sparsely populated. The method would then be justified in an area where surface records comparable in quality with hole records may be obtained, but where shot hole drilling costs are excessive. Incidentally, in some areas of this type, permits may often be secured for $5 per location as compared with $25 for shot holes. The Poulter method has its greatest usefulness, however, in those areas where record quality using surface shots is considerably better than with shot holes. This would represent the second of these conditions.

In the past, the introduction of any new improvement in the seismic method has usually presented the geophysicist with a new set of problems. In some cases several years were required in order to formulate new procedures, etc., for general use of the method. A good example of this would be the introduction of the reflection method in Oklahoma during the early 1930's.

Consider some objections to the surface shooting method. The first objection to the use of the method is the fear that damages will be excessive. A second objection would be that the weathering problem might be too hazardous or else might require too much effort for its solution.

A great deal may be accomplished toward overcoming the first of these objections by a thorough educational and public relations program in the

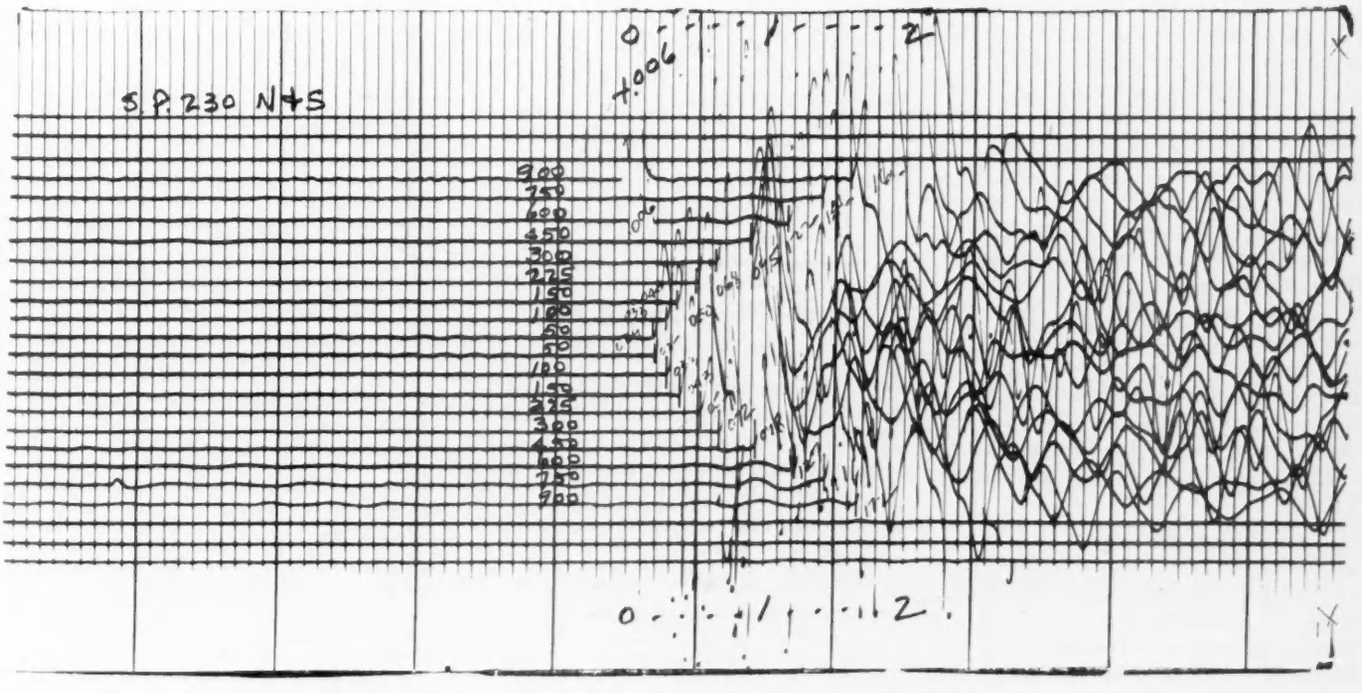


FIGURE 1. Typical weathering record obtained in the Oklahoma Panhandle.

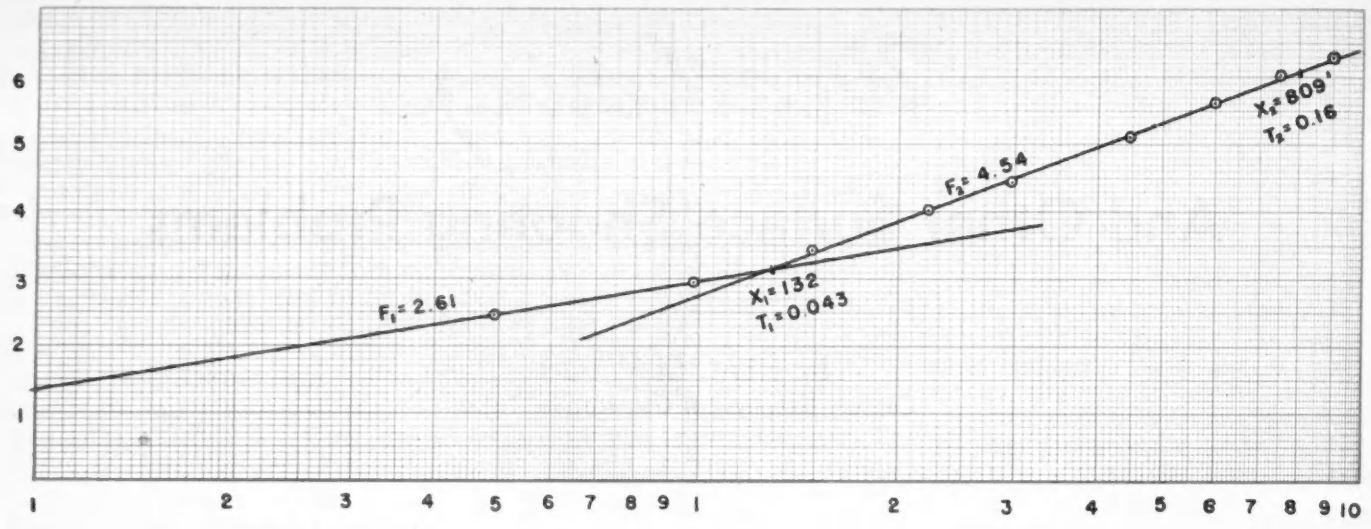


FIGURE 2. Fan or profile number 230 N-S; Date: 12-13-50; Prospect 2072-S. $B_1 = 460 - 128 = 332$; $B_2 = 732$; therefore $F_1 = 2.61$, $F_2 = 4.54$. Let $D = 200$ feet, $P_1 = 132/2.61 = 51$ feet; $d - P_1 = 149$ feet; $X_2 = (149) \times (4.54) + 132$ feet $= 677 + 132 = 809$ feet; therefore, $T_2 = 0.161$. $T_2 - T_1 = 0.118$ seconds. $t_1 = 51/2.61 = 0.0195$; $t_2 = 0.118/4.54 = 0.0260$; therefore, td for 200 feet = 0.0445 seconds.

area to be worked. This usually means each crew must have a "Grade A" permit man assigned to it. Recently it has been found that excellent records may be obtained with much smaller charges than were formerly believed to be necessary. This one factor alone has reduced damage claims considerably.

Difficult Problem

The weathering problem is, as a rule, the most difficult one the interpreter is required to solve. It should be pointed out here that no method of weathering computation can be expected in all cases to approach the accuracy of a measured "uphole time." However, certain refinements for any given area can be made which will give comparable accuracy in most cases.

While the writer is not familiar with all of the various types of reflection instruments now in use, it's doubted that good refraction breaks can be obtained with conventional amplifier filters in areas of thick weathering. If usable refraction breaks are to be recorded in areas where the low velocity layer is of the order of 150 feet thick, a set of low pass or flat response filters will be necessary. In most instances this means modification of the conventional instruments will be required.

In addition, possession of a set of low pass filters may enable the interpreter to dispense with weathering shots in areas where a high speed refractor is present a few hundred feet below the surface. A secondary refraction record may often be obtained simply by firing a small single charge at each location with the low pass filters in use. This refractor is mapped and used as a datum plane in the computations. Such a procedure would be possible over large areas in West Texas and New Mexico.

There are other factors involved in securing "good" weathering information. The choice of a suitable method of computation is one. This is especially true in areas of marked topographic relief. The writer believes that in such areas a modified curved path method is best. The use of multiple geophones for weathering shots is not recommended. In some areas a constant geophone interval is not advisable. The optimum geophone spacing for a given area can usually be determined by the time a few miles of line have been completed.

A method of weathering computation similar to that described by Banta[1] enables the interpreter to "peel off" a given thickness of surface material, often two or three times the actual weathering thickness. Provided the "first breaks" are reliable, this method takes into account any change from location to location in the sub-weathering velocity. Most other methods of computation usually assume a constant sub-weathering velocity for a given area. It is generally recognized that in many areas this velocity is variable.

Weathering Record

Figure 1 is an example of a typical weathering record obtained in the Oklahoma Panhandle. The sharpness of the "breaks," as well as the variable geophone spacing, should be noted. The charge used was one and one-quarter pounds.

Figure 2 is the corresponding plot of the data from Figure 1 on log log paper. A "peel off" time of .045 second for 200 feet is indicated. While no checks of such "calculated" times with actual uphole times have thus far been made in this area, actual uphole times for shot holes up to 400 feet in depth in Hemphill County, Texas, checked the method very well.

It must be remembered that the weathering problems associated with surface shooting are the same as those faced by geophysicists in the early days of correlation shooting. If they were able to solve such problems then, there is no reason why with a reasonable amount of effort, they should not be able to do so now.

Order Your Copy of 1950 World Oil Index

The complete editorial index covering all issues of WORLD OIL published during 1950 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to all subscribers who write requesting copies.

Orders should be addressed immediately to the Circulation Department, Box 2608, Houston 1, Texas, as quantities are limited.

REFERENCE

[1] H. E. Banta, "A Refraction Theory Adaptable to Seismic Weathering Problems," Geophysics, Vol. VI, No. 3, July, 1941. Pp. 245-253.

Clay Mineralogy

And the Petroleum Industry

By RALPH E. GRIM
Research Professor of Geology
University of Illinois, Urbana

THE development of X-ray diffraction, differential thermal, and improved microscopic techniques beginning about 25 years ago permitted the analysis of clay materials in sufficient detail to establish the concept that soils, clays, and shales generally are composed essentially of extremely small flake-shaped or elongate crystalline particles of one or more of a small group of minerals known as the clay minerals. Quartz, feldspar, calcite, and other minerals may also be present in clay materials in varying amounts and, in some instances, these components may exert a controlling influence on the characteristics of the material.

On several occasions the writer[6,7] has discussed some aspects of the relation of clay mineralogy to the discovery and recovery of petroleum. In the present paper, it is desired to consider some additional features of this subject, and to point out lines of clay mineral researches that should yield extremely valuable results on this problem.

The important groups of clay minerals and their general compositions are as follows:

Kaolinite $(OH)_8Si_4Al_4O_{10}$

Halloysite $(OH)_8Si_4Al_4O_{10}XH_2O$ (X=O to 2)

Montmorillonite $(OH)_4Si_8Al_4O_{20}XH_2O$ (always some replacement of aluminum by iron and/or magnesium, and the replacement may be complete; the silicon may be replaced to a very limited extent by aluminum)

Illite $(OH)_4K_y(Si_{8-y} \cdot Al_y)(Al_4 \cdot Mg_4 \cdot Mg_6 \cdot Fe_4)O_{20}$ ($y<2$; may resemble muscovite- or biotite-type mica in structure and composition)

Chlorite $(OH)_4(Si_6Al_2)(Mg_6 \cdot Fe_6)O_{20}(OH)_{12}(Mg_4Al_2)$

Vermiculite $(OH)_4(Si \cdot Al)_8(Mg_6 \cdot Fe_6)O_{20}8H_2O$

THIS ARTICLE deals with various aspects of the relation of clay mineralogy to the discovery and recovery of petroleum. Studies of clay minerals have indicated that certain of these or combinations of them commonly are prevalent in particular kinds of sediments, such as lagoonal, nonmarine, or marine, or in sediments formed in desert environment. Thus, clay mineral composition can be used as a reliable key for determining the environment of formation of a sediment. However, the study must be done in sufficient detail so that the particular member of a group is identified and not merely the group itself.

Sepiolite-attapulgite-palygorskite (except for attapulgite with a composition of $(OH_2)_4(OH)_2Mg_5Si_8O_{20}4H_2O$ the composition and structure of these clay minerals are not well known.

Charge Deficiency

In the case of the montmorillonite and vermiculite mineral groups, the substitutions within the lattice cause an unbalancing of charges. The charge deficiency is balanced by external exchangeable ions. All the clay mineral groups, except sepiolite-attapulgite-palygorskite, have layered structures. The structural limitations of the sepiolite-palygorskite minerals are not thoroughly known but double silica chains as in amphibole structures seem to be the fundamental structural units.

The above listed clay minerals represent groups rather than individual species. The common groups of clay minerals are widely distributed either singly or mixed together in sediments of different kinds and of different origins. Recent work, particularly the very valuable studies by Millot,[11] is showing that there are certain general correlations between clay mineral composition and the environments of accumulation of sedimentary rocks. For example illite and chlorite clay minerals are particularly prevalent in lagoonal sediments, whereas kaolinite is prevalent in nonmarine sediments. Marine sediments appear to be chiefly composed of illite with kaolinite frequently present in small amounts. Certain of the sepiolite-palygorskite minerals are rather restricted to sediments formed in a desert environment.

The writer wishes to suggest that investigations of the relation of clay mineralogy to the origin of sediments to be really fruitful, so that clay mineral composition can be used as a reliable key for determining the environment of formation of a sediment, must be done in sufficient detail so that the particular member of a group is identified and not merely the group itself. It will be necessary to determine the kind of illite or kaolinite and not merely the presence of an illite or kaolinite type clay mineral in a sediment.

Some examples will serve to illustrate this point. Recent careful X-ray work[2] on kaolinite has shown that there is considerable variation in the kaolinite-type minerals depending on the perfection of crystallinity of the kaolinite. The significance of this variation is not fully known, but it is interesting that the so-called underclay beneath Carboniferous coals which has many uniforms attributes the world over is characterized by relatively poorly crystallized kaolinite, except when it has the properties of flint clay and then the koalinite is well crystallized. The mere determination of kaolinite in such clays is not ade-

quate to show the significant difference in their compositions.

Again careful X-ray diffraction work[3] has shown the polymorphic character of the chlorites. Thus the chlorite-type of mica may be composed of stacks of units of one or several silicate layers and the manner of stacking may be different. In some chlorites the stacking is of individual layers, in others of units composed of two layers, and so on. No one yet knows the genetic significance of the various polymorphic forms, but some relationship would be expected. For example, the chlorite formed by diagenetic processes from montmorillonite may well be different from that formed from other material, say kaolinite, and different also from detrital chlorite.

It has been the expressed opinion of many geologists, engineers, and others that clays are the end product of weathering and are, therefore, everlasting unchanging materials to which nothing further is likely to happen. Nothing could be further from the truth. Clays and soils develop in response to certain environmental condition such as pH, character of prevalent cation, drainage, time, etc., and if there is a change in the environmental conditions there is almost certain to be a change in the character of the clay mineral composition of the material. This applies to an environment in which clay materials are accumulating as well as to an environment in which weathering and soil-forming processes prevail.

The clay minerals have considerable adsorption capacity for ions of various kinds and also for water. The ion and water adsorbing capacity are interrelated so that the nature of the ion determines to a large extent the amount of water that can be adsorbed.

Ion Substitution

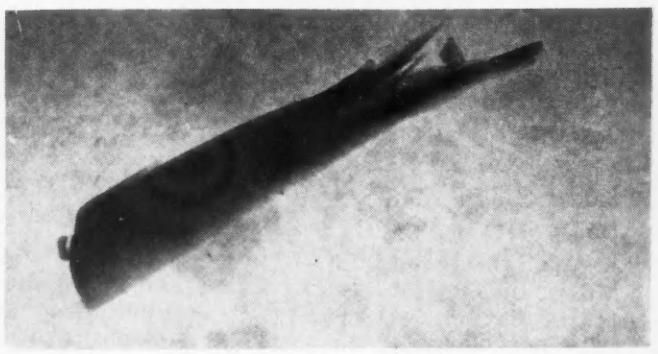
The change in the nature of the soil or clay in response to an environmental change may be only the substitution of one exchangeable ion for another. This, however, may be of great significance since two clays of similar composition in every way except in the nature of the adsorbed ions will frequently have very different properties. This can be illustrated from man-made activities. Construction activities involving excavations cutting into the water table or in any way changing the pattern of movement of water through the soil are likely either to enhance or retard leaching processes in the soil with a correlary base exchange reaction. Engineers are well aware that such a change in environmental conditions may cause a change in the plastic, compaction, and sensitivity characteristics of a soil that may be catastrophic.

The change in clay mineral composition resulting from a change in environmental conditions may be more than an adsorption phenomenon. It may well result in the development of a different clay mineral. Clay mineral investigations have reached the place where the conditions favorable for the formation of the various clay minerals are known in a general way.

In weathering processes if the rock material being altered is essentially free of alkalis or alkaline earths, i.e. composed essentially of only alumina and silica as in some kaolins, the weathering product will be a lateritic material or a podsolic material, showing a concentration of silica in the surficial horizons, depending on conditions of climate, topograph, time, etc.,

However, very rarely is there any substantial area of rock without an appreciable amount of alkali or alkaline earth being present. With such parent rocks the resulting product of weathering depends, at least in the initial stages, on the relative rate of removal of the alkali and/or alkaline earth following their liberation from the primary minerals containing them. The weathering product depends also on the kind of alkali or alkaline earth that is present.

Thus, if a basic igneous rock is altered under conditions of topography, drainage, rainfall, vegetation cover, etc., so that the magnesium and other alkaline earths and the alkalies from the hornblendes, pyroxenes, etc., are carried out of the environment by groundwater movement as soon as they are released by the breakup of the original minerals, lateritic or podsolic material will be the weathering product depending on the climate. If, however, because of poor drainage, low rainfall, etc., the magnesium is



ABOVE: Montmorillonite from Tatatila, Mexico, showing one large aggregate and a matrix background of extremely fine material.

LEFT: Illite (glauconite) from Illinois, showing irregular flake-shaped units.

Measure The Work Your Line Has Done and Avoid Wasting or Overloading

Figure Ton-Mileage With This Free Union Wire Ton-Mile Indicator

Now, many drillers are coming up with the better wire rope performance and lower wire rope costs which rig owners have been demanding. By using the Union Wire Ton-Mile Indicator, they are establishing the correct time for cutting off on each hole. This enables them to avoid cutting the line too soon or too frequently which wastes rope. And, it enables them to prevent overloading and the resulting line breaks and costly fishing jobs. And, they have found out which rotary line delivers the most ton-miles.

The Union Wire Ton-Mile Indicator is easy to use. Merely set the figures from your well log book on the indicator. It does all the complicated figuring for you. You read the answer. Easy as that!

Get Your Union Wire Ton-Mile Indicator Now

Mail the coupon on this page. A Union field representative will deliver your free Ton-Mile Indicator to you and show how easy it is to use. He will also give you a handy Union Log Book to help you keep well records.

union Wire Rope

MAIL THIS COUPON

UNION WIRE ROPE CORPORATION

Specialists in Wire Rope

2104 Manchester Ave. Kansas City 3, Mo.

Gentlemen: Please have your field man deliver my Union Wire Ton-Mile Indicator and explain its use.

*Name*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

not removed as soon as it is released, but remains in the weathering environment, then montmorillonite will be the weathering product. If leaching and removal of the magnesium is taking place at a slow rate, montmorillonite will be an intermediate product and the lateritic or podsolic material a later product.

If a granitic rock or shale which has an appreciable content of potassium is altered under conditions so that all the potash as well as the other alkalies are leached as fast as they are liberated, lateritic or podsolic material will be the weathering product depending on the climate. If the potash remains in the environment after being freed from the parent minerals, illite will be the weathering product. Again under mild leaching, illite will be a first product with lateritic or podsolic material forming later.

In areas of very high magnesium content such as in some desert basins, the sepiolite-palygorskite minerals are the alteration product.

In environments of accumulation, diagenetic changes in accord with the foregoing generalities would be expected and that is what the available data suggest. In marine conditions the tendency is to form illite type of clay minerals perhaps with some montmorillonite but with little kaolinite. In fact, in some cases at least,[8] the kaolinite tends to change over to chloritic mica material. Under nonmarine conditions, there are likely to be considerably less diagenetic changes, and here kaolinite is probably in equilibrium so that it will persist.

The changes resulting from changes in environment may take place rapidly. The speed of their reactions from the point of view of the geologist is surprising. It has, for example, been shown that in a year or less illite is formed in certain soils as a consequence of the addition of potash fertilizers. Available evidence suggests that diagenetic changes take place quickly after accumulation at least in the marine environment.

Catalytic Activity

Catalysts prepared from certain types of clay are used extensively in the refining of petroleum, and it is a well known fact that some of the clay minerals have distinct catalytic activity. The writer[6] and others[4] have suggested earlier that the clay minerals may well have been the instrument causing the transition of buried organic material to hydrocarbon compounds.

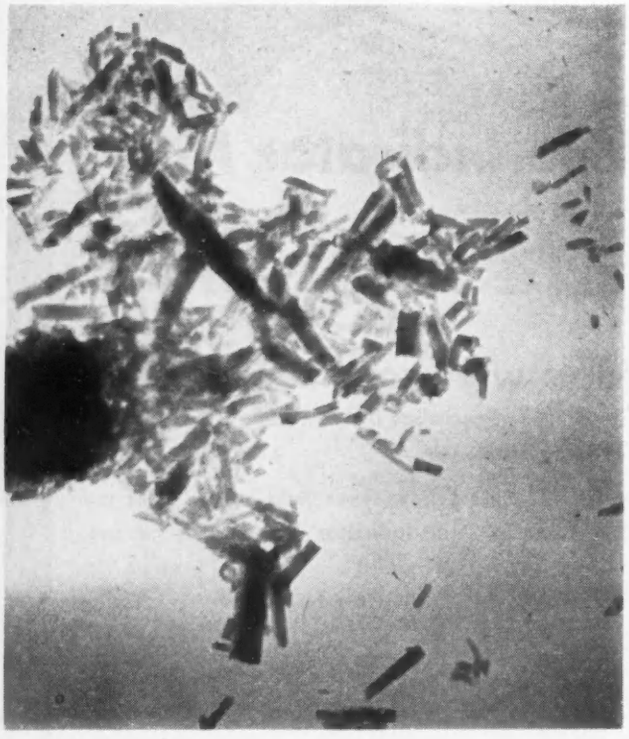
It should be noted that there is a tendency to consider as catalytically active only those materials which catalysis a reaction yielding useful products. Clay materials are known which actually have higher real catalytic activity than currently used material, but they have no economic worth and are not generally considered as catalysts because the products of the reactions catalyzed are not usable commercially.

There is great need for a careful study of the possible catalytic effect of various types of clay mineral on organic material accumulating now and that associated with recent sediments. This work needs to be done without too many preconveived conclusions as to exactly what will consitute catalytic activity. Further such work should include careful investigation, not only of the reaction products, but of any residues that are left behind in the clay.

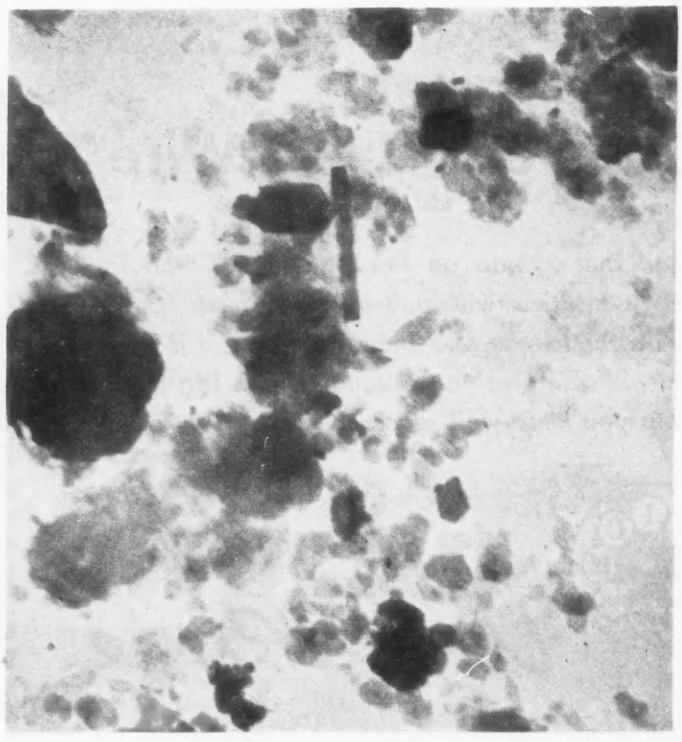
In the use of clay catalysts commerically, graphitic carbon and sulfur compounds develop on the catalytic surface as the catalysts are used. It is likely that some such compounds would be left behind if the clay minerals acted as a catalyst in nature, and careful researches might well reveal certain carbon and sulfide compounds in certain associations with the clay mineral structures that would be a key to the determination of past catalytic activity of these minerals.

The montmorillonite group of clays are generally the most active catalytically, but the degree of activity and the nature of the reaction catalysed varies widely in different montmorillonites. Some montmorillonites can be used in the preparation of commercial catalysts whereas others are of no value at all for this purpose. The explanation for this variation is not known, but it is obvious that there is some factor of composition, of structure, or both, that determines catalytic activity.

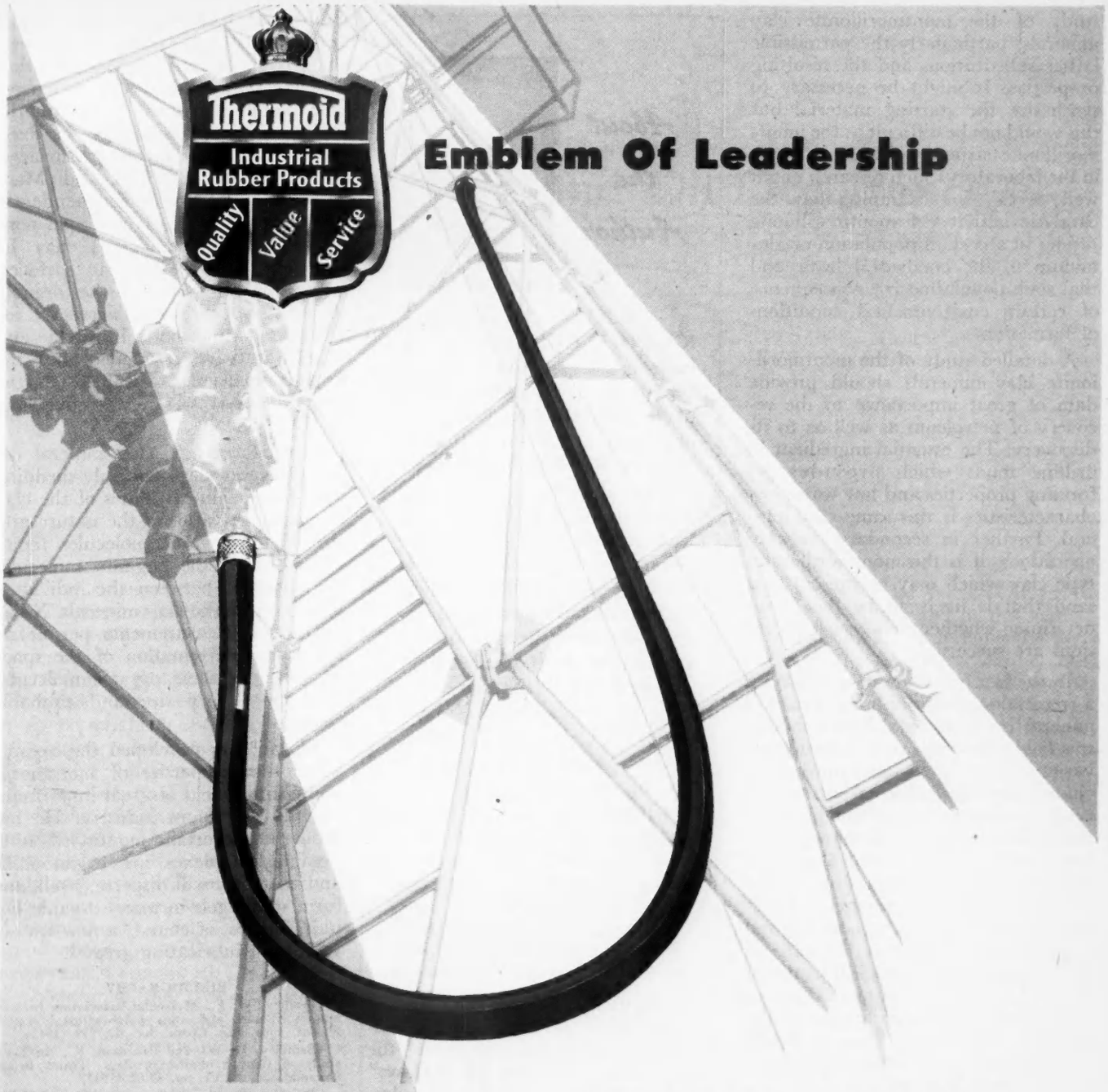
There is great need for a detailed



Halloysite from Indiana, showing tubular shape of the units.



Kaolinite from Illinois, of the poorly crystallized variety, showing crude hexagonal shape of the flakes.



Emblem Of Leadership

There's no substitute for experience—or for quality. Drillers with a life-time of experience select as their *first choice* Thermoid Powerflex Rotary Hose for safety, dependability, and economy.

Powerflex Rotary Hose is tested to 5000 psi before shipment—a test far more severe than the most grueling field operations . . . Tube is synthetic rubber, oil and abrasion resistant —reinforced with steel cables and prestretched fabric . . . Cover resists aging, abrasion, cracking . . . Couplings are built-in and anchored securely for life of hose.

Thermoid Powerflex Rotary Hose is an achievement in *advanced* hose engineering . . . it is a typical example of the high quality which has made all Thermoid Oil Field Products leaders in the oil fields.

Midcontinent office and warehouse: Houston, Texas

Thermoid

Powerflex Rotary Hose • Trioflex Slim-Hole Rotary Hose • Mud-Flo Slush Pump Hose • Flexible Discharge Units • F.H.P. and Multiple V-Belts • Oil Country Flat Belting

Wire Line Turn Backs • No-Wip Line Savers • Stuffing Box Rings • All Types of Hose • Molded Specialties • Brake Blocks

Thermoid Company • Offices & Factories: Trenton, N. J., Nephi, Utah

study of the montmorillonite clay minerals, particularly the permissible lattice substitutions and the resulting properties. It might be necessary to synthesize the starting material but this would not be difficult as the montmorillonite structure is easy to make in the laboratory. Such research might well reveal, for example, that the catalytic activity of montmorillonite resides in a certain population of aluminum in the octahedral layer and that such population is a consequence of certain environmental conditions of formation.

A detailed study of the montmorillonite clay minerals should provide data of great importance to the recovery of petroleum as well as to its discovery. The essential ingredient in drilling muds which provides gel forming properties and low water loss characteristics is this same clay mineral. Further in secondary recovery operations, it is the montmorillonite-type clay which may be present in a sand that is likely to be the factor deterining whether or not such operations are successful.

In the last few years there has been a tremendous surge of interest in clay mineral investigations. Researches in this field have been started in a large variety of different laboratories including agricultural research stations, ceramic laboratories, oil company research laboratories, government laboratories in the field of geology, engineering, and mining, and university laboratories in departments of geology, chemistry, physics, ceramics, and engineering. In 1948 at the time of the International Geological Congress in London there was organized an International Committee for the Study of Clays. Prior to this time there had been organized in England, France, Sweden and Belgium so-called Clay Mineral Groups which were rather informal associations of all those interested in clay researches. The International Committee gathered together all the Clay Mineral Groups and has representation from other countries, including the U.S., where national associations have not yet been organized. Plans are currently under way looking toward the organization of a Clay Mineral Group in the U.S.

The organization of such groups and the international committee is of great value because it brings together all those interested in clay mineralogy whether they approach the subject from the point of view of chemistry, ceramics, geology, or what not. This is, of course, important because the work being done in one field may be of great value in another field. For example some excellent work now in progress in an English ceramic laboratory on the precise nature of the organic material in "Ball Clays" should provide interesting and important information in the study of the origin of oil.

Last summer the International Committee for the Study of Clays arranged and held its first general meetings in Amsterdam at the time of the International Soil Congress. More than 100 persons actively engaged in clay mineral researches were present from all over the world, and the meetings were considered a great success by all those attending. Plans are being made for a second general meeting in Algiers in 1952 at the time of the next International Geological Congress.

Many subjects were considered in papers and in discussion at the Amsterdam meetings, but particular interest was given to the adsorption of organic substances by the montmorillonite and halloysite clay minerals. Some years ago Gieseking[5] showed that large organic ions, including proteins may replace the exchangeable metallic cations in montmorillonite and as a consequence be fixed on the basal plane interlayer surfaces. More recently Bradley[1] and MacEwan[10] working quite independently have shown that certain simple nonionized organic molecules may be held on the basal plane surfaces. Some polar groups in the organic molecule appear to be necessary for adsorption, and both Bradley and MacEwan have concluded that the organic molecules are held to the clay mineral surface through an O-H-C bond.

Investigations of clay mineral organic reactions are not only shedding light on certain attributes of the clay minerals, but also on the nature and size of the organic molecules themselves. Since the organic molecules are adsorbed between the individual unit layer of the clay minerals, X-ray diffraction measurements permit an accurate determination of the space occupied by these organic molecules and thus, their size and probable shape.

Jordan[9] has developed the organic adsorptive properties of montmorillonite into a field of great importance for the petroleum industry. He has shown that certain montmorillonite-organic complexes are organophilic and that they will disperse, swell, and form stable gels in many organic liquids. This is, of course, a new way of stabilizing lubricating greases.

About the Author

RALPH E. GRIM received his bachelor's degree from Yale University in 1924 and his doctor's degree from the State University of Iowa in 1931. From 1931 to 1950 he was with Illinois State Geological Survey as geologist and petrographer in charge of clay research. In 1950 he became research professor of geology at the University of Illinois, where he had worked part-time for two years. In 1942 he organized a symposium on clay mineralogy as part of the celebration of the 50th anniversary of the founding of the University of Chicago. He is American representative on the executive committee of the International Committee for the Study of Clays, and in 1950 was vice president of the Mineralogical Society of America.

BIBLIOGRAPHY

[1] Bradley, W. F., Molecular association between montmorillonite and some polyfunctional organic liquids, Jour. Am. Chem. Soc. 67, 975 (1945).

[2] Brindley, G. W., and Robinson, K., An X-ray study of some kaolinitic fireclays, Trans. British Ceramic Soc. XLVI, pp. 49-62 (1947).

[3] Brindley, G. W., Oughton, B. M., and Robinson, K., Polymorphism of the chlorites; I Ordered Structures. Acta Crystallographica, Vol. 3, pp. 408-415, (1950).

[4] Brooks, B. T., Active-surface catalysts in formation of petroleum, Bull. Am. Assoc. Pet. Geol. 32, pp. 2269-2286 (1948).

[5] Gieseking, J. E., Mechanism of cation exchange in montmorillonite-beidellite-nontronite types of clay minerals, Soil Sci. 47, pp. 1-14 (1939).

[6] Grim, R. E., Relation of clay mineralogy to the origin and recovery of petroleum, Am. Assoc. Pet. Geol. 31, pp. 1491-1499 (1947); Rept. Inv. 125, Ill. Geol. Survey (1947).

[7] Grim, R. E., Clay mineralogy in the discovery and recovery of petroleum, Tulsa Geol. Soc. Digest XVIII, pp. 31-33 (1950).

[8] Grim, R. E., Bradley, W. F., and Dietz, R. S., Clay mineral composition of some sediments from the Pacific Ocean off the California coast and the Gulf of California, Bull. Geol. Soc. of Am. 60, pp. 1785-1808 (1949).

[9] Jordan, J. W., Organophilic bentonites; I Swelling in organic liquids, Jour. Phys. Coll. Chem. 53, No. 2, February, 1949.

[10] MacEwan, D. M. C., Complexes of clays with organic compounds, Pt. 1, Complex formation between the clay minerals montmorillonite and halloysite and certain organic liquids. Report of Research No. 1, Rothamsted Experiment Station, Harpenden, Great Britain (1947).

[11] Millot, Georges, Relation entre la Constitution et la Genese des Roches Sedementaires Argileuses. "Geologie Appliquee et Prospection Miniere II, Nos. 2-3-4, 352 pp. 1949.

Sedimentary Basins and Oil Occurrence

By L. G. WEEKS

Chief Research Geologist

Standard Oil Company (N. J.), New York, N. Y.

THE incidence of oil occurrence in sedimentary basins is closely related to two groups of basic factors. The first of these concerns the genetic type, manner of growth, and the architecture (the physical framework and the bottom form or configuration) of the basins at the time of deposition. The second concerns the conditions within the basin and on the basin bottom during and immediately following deposition. The second of these groups of factors is closely related to, and largely dependent on, the first.

It is not the scope of this brief article to present a detailed examination of those broad features of the earth's crustal framework which basically determine the genesis, history, and resulting type of basin; nor does space permit description or illustration of the manner of evolution of the types of basin that evolve in the different parts of that fundamental framework. This has already been done in the course of a series of lectures under the auspices of the Distinguished Lecture Committee, American Association of Petroleum Geologists.[1]

ALTHOUGH OIL men are becoming more conscious of the role that sedimentary basins play in oil accumulation, many erroneous conceptions exist. While basin areas are potentially prolific oil producers, not all basins necessarily are productive. This fact is demonstrated by an understanding of the forces that combine to form sedimentary basins. In the course of the formation of sedimentary basins, there are fundamental differences in type of environment and resulting facies and conditions which either strongly favor or largely preclude the occurrence of oil. Basinwise, there is vast variability in the incidence of oil occurrence. Fully 80 percent of the commercially recoverable hydrocarbons in the world is accumulated in pools that are scattered through areas that comprise only 20 percent of the total sedimentary basin area of the world.

This paper is for WORLD OIL readers who are interested in the fundamental principles underlying the formation of sedimentary basins. Oil men are becoming more conscious of the role which sedimentary basins play in oil accumulation, although many erroneous conceptions exist and it is well to make plain that, while basin areas are potentially prolific oil producers, not all basins are necessarily productive. An understanding of the forces which combine to form sedimentary basins clearly demonstrates this fact.

In the course of the formation of sedimentary basins it must be understood that there are fundamental differences in the type of environment and resulting facies and conditions which either strongly favor or largely preclude the occurrence of oil. Basinwise, there is vast variability in the incidence of oil occurrence.

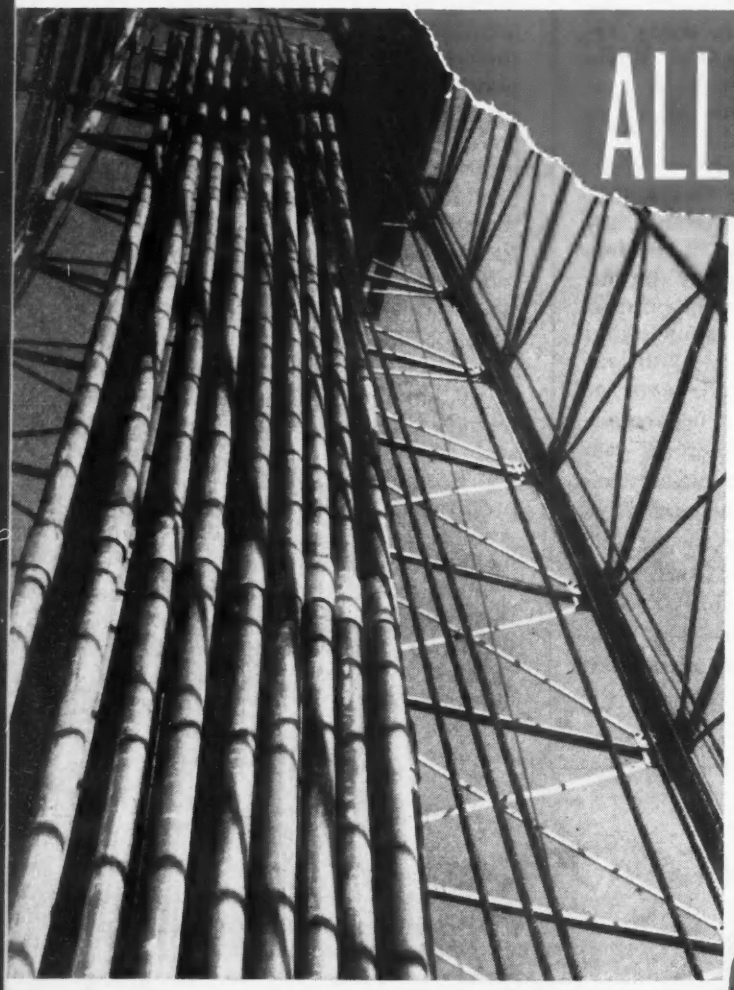
In this general discussion, consider that the framework of the crust of the earth is essentially comprised of (a) relatively stable regions, and (b) linear mobile belts. The latter consist of geosynclines of deposition and, usually, bordering geanticlinal welts.

About the Author

LEWIS G. WEEKS, chief research geologist, Standard Oil Company (N. J.), is the author of a number of important works in connection with petroleum geology, including a discussion of potential oil reserves presented before the United Nations Scientific Conference on the Conservation and Utilization of Resources. He is a graduate of the universities of Wisconsin and Cornell and has practiced geology not only in this country but in practically all of Latin America. He joined Jersey Standard in 1924; served as president of Standard Oil Company of Bolivia from 1934-38; and was elevated to his present position in 1938.

AGAIN— they're using National Seamless

because it's uniformly strong—



ALL THE WAY DOWN!

THERE isn't a driller, toolpusher or crew anywhere that can do an outstanding job without outstanding equipment. That's why so many of this country's famous wells have been drilled with National Seamless Drill Pipe, Casing and Tubing . . . exclusively.

Money just can't buy a better oil country tubular product than seamless. Each length is pierced from a solid billet of steel. This method of manufacture is one of the most drastic forming operations in the steel business—but it gives the strongest, most dependable steel section obtainable.

All drill pipe is seamless because only seamless has the great strength necessary to withstand the tremendous stress of drilling. But don't stop with drill pipe. Use seamless casing and tubing, too; give *all* your tubular products the advantages of seamless construction: uniform wall strength, tough joints, high collapse resistance.

Remember, if seamless is best for drill pipe, it's best for casing and tubing, too! And for tops in seamless, get National Seamless, America's preferred drill pipe, casing and tubing.

Write for Bulletin 15. National Tube Company, Frick Building, Pittsburgh, Pa.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS TRADE MARK

NATIONAL SEAMLESS

drill pipe...casing...tubing

UNITED STATES STEEL

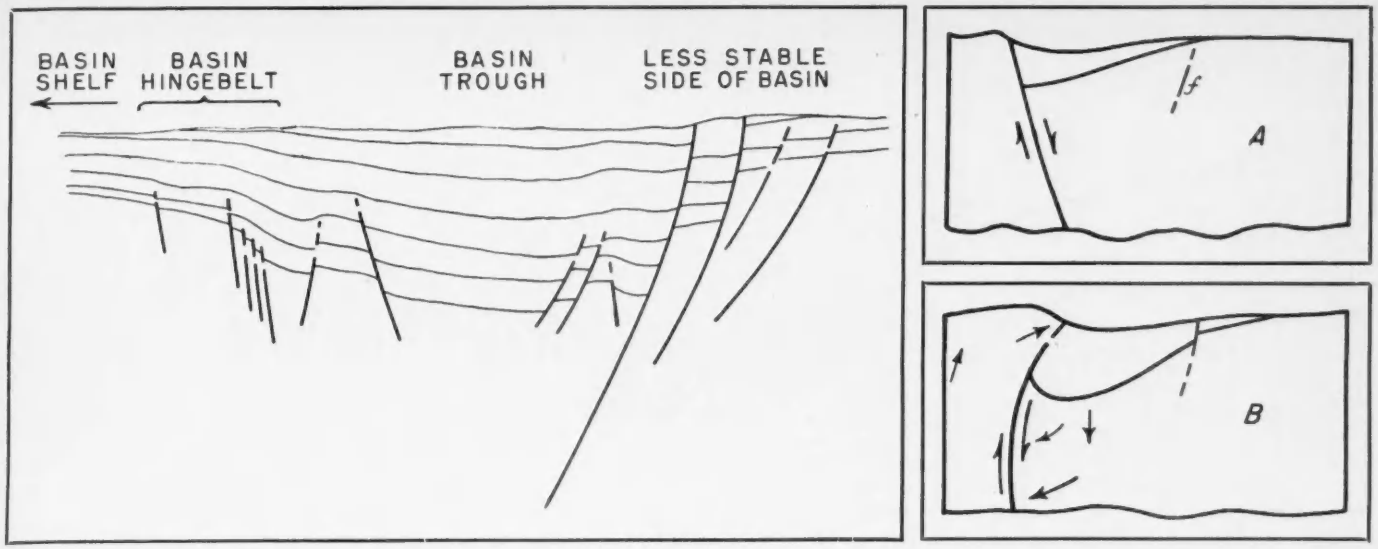


FIGURE 1 (left). Diagram to illustrate a common form of basin subsidence resulting from removal of support in the subcrust. Part of the adjustment to subsidence may occur along numerous lesser faults not shown in the diagram. Some are microscopic in size.
FIGURE 2 (right). Simple sketch of two stages in development of a mobile asymetric basin which began as a half-graben.

The continents, even to including the central cores or shields, have grown by addition of concentrically developed mobile belts that have ultimately become stabilized. As a result, the paleography of each succeeding major diastrophic-sedimentation cycle is, in its broader aspects, radically different from those preceding.

The lengthy geosynclines of the mobile belts do not consist of uniformly continuous troughs. They are comprised of a succession of deposition sinks, roughly ovate in shape and separated, often in an "en echelon" manner, by saddles.

The strain results of stresses, which gave us the deposition basins of the past and the structure basins of today, are widely different in the mobile belts from those of the stable regions.

In many, probably most, basins, subsidence is essentially a gravity sag phenomenon (Figure 1). In this respect, basins generally, even those of the belts that ultimately became highly mobile, began their existence and renewed their subsidences by downfaulting. These faults were minor, producing simple basinal sags, or they were abrupt, producing graben or half-graben.

In the stable regions the basins did not generally evolve beyond the simple original basin stage of graben, half-graben or more truly synclinal sags. But, as the belts of mobility are approached in space, or as the basins of the mobile belts themselves (which also began as graben, half-graben or more truly synclinal sags) evolve with time to more advanced stages of mobility, the master border faults evolve into high-angle upthrusts, and the basin form, including the frontal folds, becomes more and more asymmetric (Figure 2). Finally, in later stages of the diastrophic-sedimentation cycle, the growing geanticlinal border welt crowds forward, with low-angle overthrusting, toward the basin and foreland beyond, incorporating much of the sediments already deposited in the geosyncline.

(Figure 3 is presented as a simple basin classification that includes essentially all types and conditions of basins or geosynclines of both the mobile belt and stable regions.)

An examination of the conditions of sedimentation and environment in the deposition basin leads to the following conclusions:

- The evolution of oil is believed to have occurred early after the deposition of the sediments and their contained organic matter. This evolution is probably, in the main, one of the diagenetic processes that affect sediments between the time of their deposition and lithification. This early period of diagenesis in which the oil is formed is one of physical, chemical, biochemical and mineralogic instability. It is therefore a period of maximum change before stability is again established in a radically new environment in the lithified sediments. As that stability is again established, the changes correspondingly cease.
- The incidence of oil occurrence varies roughly both in space and in time with the degree of mobility. World-wide analysis has shown it to be high in and around the mobile sinks of deposition, particularly where silled. (Figure 4 shows a cross-section of a well-silled basin and is designed to illustrate the relationships of the litho- and biofacies to the oxidation-reduction potential in the aerated and stagnant zones.)

It is not an exaggeration to state that fully 80 percent of the commercially recoverable hydrocarbons in the world are accumulated in pools that are scattered through belts of areas that comprise but 20 percent of the total sedimentary basin area of the world.

- Sediments deposited slowly on uniformly open, aerated, stable sea bottoms are not generally favorable for oil occurrences. Major areas of this sort in even the most prolific of basins (comprising in cases as much as one-half or even three-fourths of the ba-

Classification of Geosynclines or Depositional Basins

GROUP	CLASS AND SUB-CLASS	
MOBILE BELT	MARGINAL (Extra-Continental)	OPEN MARGINAL
		CLOSED MARGINAL
	INTRA-CONTINENTAL	
	INTERMONTANE	GRABEN HALF-GRABEN OR SYNCLINAL
	MEDIAN MASS	
STABLE REGIONS	FORELAND SHELF	
	CONNECTED INTERIOR	
	DISCONNECTED INTERIOR	
	GRABEN OR HALF-GRABEN	
	STABLE COASTAL	

FIGURE 3

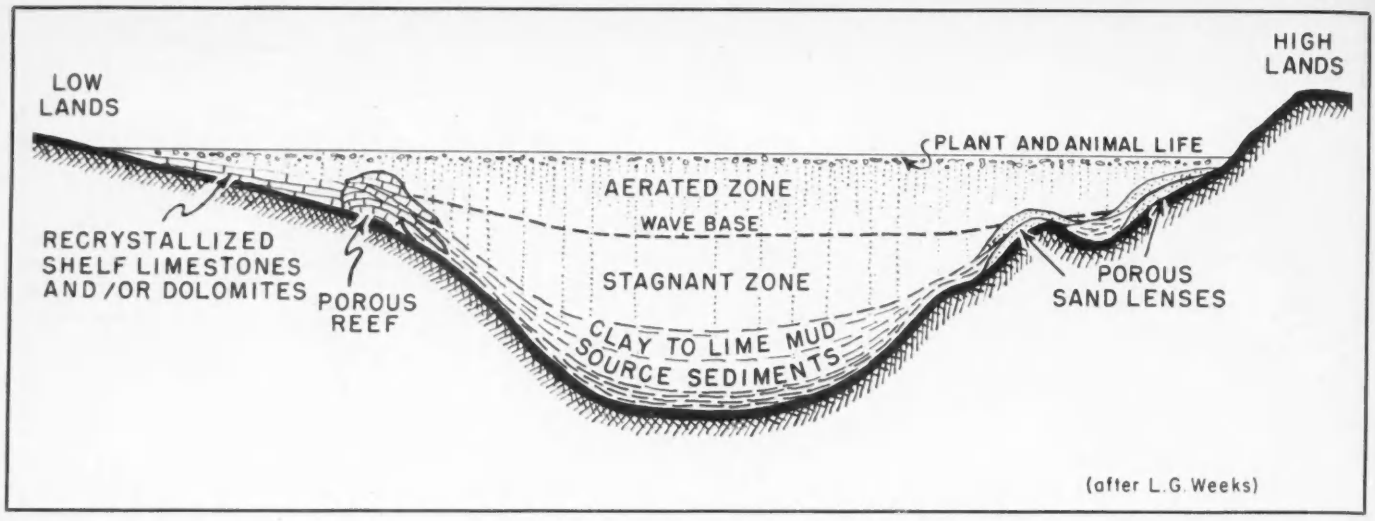


FIGURE 4. Silled or restricted deposition basin. This illustrates the general relation of the aerated and stagnant zones to effective wave base; and a characteristic distribution, basinwise, of the resulting sediment facies.

sin) are commonly barren or largely barren of oil.

● In an analysis of the more important factors and conditions of sedimentation and environment that influence or characterize the resulting facies in the basin of deposition it must be pointed out that, while petroleum is a normal constituent of sedimentary rocks, commercial accumulations cannot as a rule occur except where both source and reservoir facies co-exist in proper relationship, one to the other. The two broad facies groups are quite distinct and separate. Normally, neither can result in oil accumulations by itself.

● Nonsource (commonly reservoir) environment and facies (Figure 5) are characterized by high basin position; that is, on the basin flanks and bottom highs, where the bottom lies near or above sill depth and relatively near effective wave base. The environment is aerobic and of positive oxidation-reduction potential. Deposition is relatively slow, bottom faunas may be abundant and preservation of organic matter is excluded by its complete exothermic decomposition. Diagenesis results in drastic changes in the sediments. These include recrystallization of carbonate sediments and dolomitization.

● Possible source (usually nonreservoir) environment and facies (Figure 5) are characterized by a relatively low basin position, well below sill depth and effective wave base. The environment is anaerobic and of negative oxidation-reduction potential. Deposition is relatively rapid, bottom faunas are largely excluded due to toxic environment, and the preservation of organic matter is possible. Due to a rapid disappearance of oxygen and buildup of carbon dioxide in a stagnant environment, deposition of lime may be largely to partially precluded. The basinal carbonate sediments thus commonly exist as marls or as shaly limestones, and generally do not attain the high degree of purity that is possible in clear aerated waters free of noncarbonate clastics. Diagenetic processes give distinctly different results from those of the aerated environs. In this respect, the colors are commonly darker and duller, the original finer textures are widely maintained, primary cherts may be abundant, minor to important parts of the original organic character may be retained, and recrystallization of limestones and dolomitization is largely absent.

Distinguishing Characteristics

Non-Source (Commonly Reservoir) Environment or Facies	Possible Source (Usually Non-Reservoir) Environment or Facies
1. Deposition on or around basin flanks and other bottom highs.	1. Deposition in relatively low basin position.
2. Positive O/R potential.	2. Negative O/R potential.
3. Aerobic environment	3. Anaerobic environment.
4. Deposition above to not far below sill depth.	4. Deposition below to well below sill depth.
5. Deposition relatively near effective wave base.	5. Deposition below to far below effective wave base.
6. Usually slow deposition.	6. Relatively rapid deposition.
7. Faunal remains largely Benthonic.	7. Faunal remains largely Planktonic, conditions unfavorable to Benthos.
8. Exothermic destruction of organic matter.	8. Organic matter preserved from exothermic decomposition.
9. Drastic and characteristic changes wrought by diagenesis. These include recrystallization of carbonate sediments with common obliteration of their original testures and structures.	9. Diagenesis less drastic, but products characteristic. Carbonate sediments are not normally recrystallized. They are usually moderately to much more shaly. Their colors are darker and duller. Original sediment textures and structures are largely maintained.
AND	AND
10. Dolomitization.	10. Dolomitization is generally absent.
11. Primary cherts, iron sulfide and rare metal compounds uncommon.	11. Primary cherts, iron sulfides, rare metals, etc., common.
12. Sediments nonbituminous.	12. Sediments commonly bituminous.

FIGURE 5

REFERENCES

[1] "Sedimentary Basin Development and Its Bearing on Oil Occurrence."

# of high INSURANCE COSTS

Occupational injuries cost over two and a half billion dollars annually. As an employer of labor, your costs of Workmen's Compensation Insurance are directly affected by the number and severity of accidents in your plant or place of business.

ACCIDENT PREVENTION Reduces COSTS

The Association's safety engineers have helped many Texas business and industrial firms reduce accident frequency and thereby reduce insurance costs by: (1) Analyzing and reporting on accident causes, (2) Recommending the proper methods of eliminating job hazards, (3) Training of supervisors in accident prevention.

Why not take advantage of this service to reduce your insurance costs?

OTHER COVERAGES

Texas firms and individuals with preferred-type risks are offered the same DIRECT SERVICE, plus a SAVING on

FIRE • AUTOMOBILE • LIABILITY
CARGO and other ALL-RISK lines

by

EMPLOYERS CASUALTY CO.
A Participating Stock Company
Companion to the Association

Largest Writer of WORKMEN'S COMPENSATION INSURANCE *in Texas*

HOMER R. MITCHELL, *Chairman of the Board* A. F. ALLEN, *President*

District Offices in: ABILENE • AMARILLO • AUSTIN • BEAUMONT • CORPUS CHRISTI • DALLAS
EL PASO • FORT WORTH • GALVESTON • HARLINGEN • HOUSTON • LUBBOCK • MIDLAND
PORT ARTHUR • SAN ANGELO • SAN ANTONIO • SHERMAN • TYLER • WACO • WICHITA FALLS

TEXAS EMPLOYERS INSURANCE ASSOCIATION
HOME OFFICE · DALLAS, TEXAS

Exploration

Makes Fast Start

THE exploratory drilling campaign got off to a good start in January with the greatest number of exploratory tests ever completed during the initial month of any year. The high drilling rate of December was carried over and maintained in January, and the number of wells completed were almost the same for the two periods.

Compared with January, 1950, the month just past held an advantage of 22.6 percent in the number of exploratory wells completed. There were 780 tests finaled during the month compared with 782 completed in December of last year and 636 drilled in January a year before.

The month compared favorably in results as well as in total wells. Successful tests numbered 149 in January to account for 19.1 percent of the total drilled. A month earlier the score had been 18.7 percent of the total, and a year before 20.1 percent of all tests drilled were successfully completed as producers.

January's exploratory efforts resulted in the discovery of 72 oil fields and 23 new oil pay horizons for a total of 95 new oil pools. New pools totaled 112 in December and 81 in January a year before.

Distillate pools amounted to eight for the month compared with five in December and ten a year earlier. Gas discoveries numbered 16 against ten a month earlier and 16 in January, 1950.

Summary of Results of Exploratory Drilling

ITEM	Jan., 1951	Dec., 1950	Jan., 1950	% Diff. Jan., '50-'51
Oil Discoveries	**95**	**112**	**81**	**+ 17.3**
New Fields	72	79	59	+ 22.1
New Pays	23	33	22	+ 4.5
Distillate Discoveries	**8**	**4**	**10**	**— 20.0**
New Fields	7	3	10	— 30.0
New Pays	1	1	....	.....
Gas Discoveries	**16**	**10**	**16**	.....
New Fields	13	8	14	— 7.2
New Pays	3	2	2	+ 50.0
Total Discoveries	**119**	**126**	**107**	**+ 11.2**
Extensions to Fields	**30**	**20**	**21**	**+ 42.9**
Oil Fields	23	18	19	+ 21.1
Distillate Fields	4	....	1	+300.0
Gas Fields	3	2	1	+200.0
Total Productive Tests	**149**	**146**	**128**	**+ 16.4**
Dry Holes	**631**	**636**	**508**	**+ 24.2**
Wildcats	594	602	466	+ 27.5
New Pays	3	....	4	— 25.0
Outposts	34	34	38	— 10.5
Total Exploratory Tests	**780**	**782**	**636**	**+ 22.6**
Percent Productive	19.1	18.7	20.1	.....
Percent Dry	80.9	81.3	79.9	.....

(See tables on 78-80)

Results of Exploratory Drilling, January, 1951, by States

JANUARY, 1951—1950

STATE or DISTRICT	PRODUCTIVE TESTS: New Fields Oil	New Fields Dist.	New Fields Gas	New Pays Oil	New Pays Dist.	New Pays Gas	Extensions Oil	Extensions Dist.	Extensions Gas	Total Productive Jan. 1951	Total Productive Jan., 1950	UNPRODUCTIVE TESTS: Wildcats	New Pays	Outposts	Total Dry Jan., 1951	Total Dry Jan., 1950	Total Exploratory Tests Jan., 1951	Total Exploratory Tests Jan., 1950
Alabama	..	..	..	..	..	..	..	..	..	..	..	2	..	..	2	2	2	2
Arizona	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	1	..
Arkansas	..	..	..	..	..	..	..	..	..	..	1	6	..	..	6	8	6	9
California	1	..	..	..	..	..	1	..	..	2	3	69	2	2	73	29	75	32
Colorado	..	..	..	..	..	..	..	..	..	..	..	9	..	1	10	5	10	5
Georgia	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
Illinois	..	..	..	1	..	..	4	..	..	5	9	39	..	..	39	45	44	54
Indiana	..	..	..	..	..	..	..	..	..	..	4	14	..	..	14	30	14	34
Kansas	19	..	..	3	..	..	..	..	..	22	9	44	..	..	44	33	66	42
Kentucky	..	..	..	..	..	..	2	..	..	2	1	9	..	..	9	3	11	4
Louisiana	1	..	..	5	..	..	2	..	..	8	14	25	..	3	28	21	36	35
North Louisiana	1	..	..	2	..	..	..	..	..	3	2	13	..	..	13	15	16	17
South Louisiana	..	..	..	3	..	..	2	..	..	5	12	12	..	3	15	6	20	18
Michigan	..	..	..	..	..	1	..	..	..	1	6	15	..	..	15	24	16	30
Mississippi	1	1	..	..	..	..	..	..	..	2	3	6	..	1	7	7	9	10
Montana	..	..	..	..	..	..	1	..	..	1	..	2	..	2	4	2	5	2
Nebraska	..	..	..	..	..	..	..	..	..	..	1	3	..	..	3	2	3	3
New Mexico	..	..	1	1	..	..	1	..	1	4	4	8	..	..	8	6	12	10
Ohio	..	..	..	..	..	..	1	..	..	1	1	3	..	..	3	1	4	2
Oklahoma	9	..	1	3	..	..	4	1	1	19	6	76	..	..	76	30	95	36
South Dakota	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
Tennessee	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	3
Texas	40	6	11	9	1	1	7	3	1	79	64	254	1	24	279	243	358	307
Dist. 1—South Central	4	..	..	..	..	..	..	..	..	4	1	17	..	3	20	18	24	19
Dist. 2—Middle Gulf	2	2	4	1	..	..	..	..	..	9	3	18	..	4	22	6	31	9
Dist. 3—Upper Gulf	1	1	2	3	..	1	..	1	..	9	7	17	..	..	17	16	26	23
Dist. 4—Lower Gulf-S.W.	1	2	..	3	1	..	..	..	..	7	11	20	..	3	23	27	30	38
Dist. 5—East Central	..	..	..	..	..	..	1	..	..	1	..	13	..	..	13	7	14	7
Dist. 6—Northeast	1	..	..	..	..	..	..	2	..	3	2	5	..	..	5	13	8	15
Dist. 7-B—North Central	10	..	2	..	..	..	1	..	1	14	11	67	..	2	69	49	83	60
Dist. 7-C—West Central	5	1	..	..	..	..	2	..	..	8	5	22	..	..	22	18	30	23
Dist. 8—West	6	..	2	2	..	..	3	..	..	13	9	36	1	6	43	37	56	46
Dist. 9—North	9	..	..	..	..	..	..	..	..	9	14	37	..	6	43	52	52	66
Dist. 10—Panhandle	1	..	1	..	..	..	..	..	..	2	1	2	..	..	2	..	4	1
Utah	..	..	..	..	..	..	..	..	..	..	..	2	..	..	2	2	2	2
Wyoming	1	..	..	1	..	1	..	..	..	3	2	7	..	1	8	10	11	12
Total United States	72	7	13	23	1	3	23	4	3	149	128	594	3	34	631	508	780	636

J&L STEEL

He's On The Right Line *to Lower Drilling Costs*

Why don't *you* join the hundreds of cost conscious oil men who specify J&L Precisionbilt Drilling Lines on their rotary or cable tool rigs?

The long service life of J&L Drilling lines has convinced drilling contractors throughout the oil country that J&L can give them the maximum hole per wire rope dollar—an important consideration in economical operation when frequent shut-downs to replace lines are expensive—both in cost of line and in cost of downtime.

There are other reasons J&L Wire rope is popular in the oil country—it's easier handling, smoother spooling, and is lubricated with J&L's exclusive, long-lasting Bronz-lube that is clean to handle—doesn't run out when the line gets warm.

Why not find out more about J&L Wire Rope Drilling Lines and how to select the right rope for the job. Write today for a free copy of our wire rope handbook, "Wire Rope is a Machine." And the next time you order drilling line—try J&L. With J&L representatives and warehouses in every part of the oil country, you can depend on prompt delivery and courteous service.

Jones & Laughlin Steel Corporation
417 Jones & Laughlin Building
Pittsburgh 30, Pa.

I am interested in using the right wire rope for the job. Please send me a free copy of your handbook, "Wire Rope is a Machine."

NAME_____

COMPANY_____

ADDRESS_____

JONES & LAUGHLIN STEEL CORPORATION

From its own raw materials, J&L manufactures a full line of carbon steel products, as well as certain products in OTISCOLOY *and* JALLOY *(hi-tensile steels).*

PRINCIPAL PRODUCTS: HOT ROLLED AND COLD FINISHED BARS AND SHAPES • STRUCTURAL SHAPES • HOT AND COLD ROLLED STRIP AND SHEETS • TUBULAR, WIRE AND TIN MILL PRODUCTS • "PRECISIONBILT" WIRE ROPE • COAL CHEMICALS

New Oil, Distillate and Gas Fields, and New Pay Horizons Discovered in United States in January, 1951

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		CALIFORN[1]A—New Oil Field						
Orange	Anaheim, S.	Patrick A. Dobeny's Holsinger 1, Sect. 22-4s-10w	1-11-51	4631	4335- 4364		P 50	10
		CALIFORNIA—Oil Field Extension						
Ventura	Ventura Ave.	Lloyd Corp. Ltd's Fee S-2, Sect. 20-3n-22w. ½ mi e extension	1-12-51	12611	11715-12200	D-6 sd; Plio.	F 500; $\frac{1}{2}$″	34
		ILLINOIS—New Oil Pay						
Wayne	Ellery, W.	Illinois Mid-Continent's Jones-Kendall 1, SE 23-2s-9e	1-30-51	3395	3109- 3117	Bethel sd; Miss.	P 108; 8 wtr	....
		ILLINOIS—Oil Field Extensions						
Clay	Ingraham	Sun Drilling Co's Hinterscher 1-A, SW NW NE 9-4n-8e. ¾ mi n ext.	1-16-51	3036	3010- 3014	Rosiclare li; Miss.	P 275	....
Edwards	Maplegrove, E.	Miracle & Steber's J. M. Luther 2, NE SW NW 13-1n-10e. ¾ mi s ext.	1-16-51	2466	2450- 2462	Waltersburg sd; Miss.	P 150; 100 wtr	....
Wayne	Clay City-Noble Cons.	Aurora Oil Co. et al's Bunting 1-A, SW NE NW 35-1s-7e. ½ mi w ext.	1 16-51	3276	3197- 3208	L. O'Hara li; Miss.	P 234	....
					3270- 3276	McClosky li; Miss.		
Wayne	Clay City-Noble Cons.	Nation Oil Co's C. Mark 1, SW SW NW 26-1s-8e. ½ mi s ext.	1-30-51	3107	3082- 3108	Aux Vases sd; Miss.	P 30	....
		KANSAS—New Oil Fields						
Barton	Fort Zarah	Nat'l. Assoc. Pet. Co.'s Harris 1, NE NE SW 30-19s-12w	1-17-51	3400	3392- 3400	Arbuckle li; Ord.	P&F 150	....
Barton	Redwing, N.W.	E. H. Adair & Holly Oil Co's Argo-Eveleigh 1, SE SE NW 31-17s-12w	1-24-51	3331	3322- 3331	Arbuckle li; Ord.	P 240	....
Barton	Werner	W. L. Hartman's Werner 1, SW NW NW 30-19s-11w	1-13-51	3400	3106- 3115	Lansing-KC li; Penn.	P 347	....
Butler	4 Mile Creek	J. P. Gaty & Graham Oil Co's Graham 1, SW SE NE 5-28s-3e	1-17-51	3072	3069- 3072	Simpson li; Ord.	F 2068	....
Ellsworth	Edwards, N.	Continental Oil Co's Shumway 1, SW SW NW 10-17s-8w	1-21-51	3167	3157- 3167	Simpson li; Ord.	P 275	39
Graham	Highland	Deep Rock & Barnett Drlg. Co's Moore 1, SE SE SE 20-8s-22w	1-17-51	3895	3615- 3620	Lansing-KC li; Penn.	P 209	....
Kingman	Dewey	Pabco Drlg. Co's Viney B-1, SW SW SW 9-28s-5w	1-15-51	3851	3805- 3811	Mississippi dolo; Miss.	F 121	....
Kingman	Lansdown, N.	Laura Jane Oil Co. et al's Seward 1, SE SE SE 4-28s-5w	1-16-51	3817	3804- 3814	Mississippi dolo; Miss.	F 148	....
Phillips	Artz	Marmad Oil Co's Artz 1, SE NW NE 19-1s-18w	1-19-51	3510	3478- 3481	Lansing-KC li; Penn.	P 24	....
Rice	Froning	J. C. Dozier's Froning 1, NE NE NW 10-18s-8w	1-22-51	3300	3222- 3238	Lansing-KC li; Penn.	P 28	....
Rice	Union, E.	Hutchins Bros. Oil Co's Ray 1, SW NW SE 27-20s-8w	1-12-51	3314	3305- 3312	Conglomerate; Penn.	F 25	....
Rooks	Berland, S.	Lohmann-Johnson Drlg. Co. et al's Sebontholer 1, NE NE NW 31-10s-19w.	1-23-51	3771	3480- 3490	Lansing-KC li; Penn.	P 169	....
Rooks	Kruse	Broadview Oil Co's Becker 1, SE NW SE 34-9s-16w	1- 9-51	3131	3092- 3120	Lansing-KC li; Penn.	P 20; 2 wtr	....
Scott	Keystone	Herndon Drlg. Co's Rueter 1, NE NE NE 25-18s-32w	1-17-51	4646	4022- 4028	Lansing-KC li; Penn.	P 143	....
Sedgwick	Fairview, S.	J. P. Gaty's Joe Tjaden 1, NE SW NE 17-26s-2e	1-10-51	2950	2945- 2950	Burgess sd; Penn.	P 38	....
Stafford	Duggan	Hexagon Oil & Pickrell Drlg. Co's Duggan 1, NE SW SW 30-21s-11w	1-21-51	3584	3489- 3495	Conglomerate; Penn.	P 470	....
Stafford	Sheppard	El Dorado Refg. Co's Sneppard 1, SE SE NW 16-22s-11w	1-19-51	3583	3547- 3548	Arbuckle li; Ord.	P 79	....
Sumner	Metz	Texas Pacific C&O Co's Metz 1, NE NE NW 7-32s-2e	1-21-51	3780	3773- 3780	Arbuckle li; Ord.	P 147	42
Wabaunsee		Carter Oil Co's Woodbury 2, SE NW NE 11-15s-10e	1-21-51	3335	3223- 3228	Viola li; Ord.	P 108	....
		KANSAS—New Oil Pays						
Barton	Fort Zarah	W. L. Hartman's Harris 1, SE SE NW 30-19s-12w	1-19-51	3416	3283- 3294	Lansing-KC li; Penn.	P 309	....
Graham	Smith-Denning	Westgate-Greenland Oil Co's Denning 2, NW SE SW 32-9s-21w	1-17-51	3857	3530- 3545	Lansing-KC li; Penn.	P 80; 50 wtr	....
Wabaunsee	Davis Ranch	Carter Oil Co's Davis 12-A (Twin) SW NW NE 33-13s-10e	1-17-51	2941	2930- 2941	Hunton li; Sil.	P 44	....
		KENTUCKY—Oil Field Extensions						
Henderson	Spottsville	Nat'l. Assoc. Pet. Co's R. L. Christensen 1, NE SW SW 20-Q-25. 1 mi ne ext.	1-24-51	2225	.....	McClosky li; Miss.	No gge.	....
Webster	Sebree	Geo. Engle's Froy Powell 1, SW SW NW 18-N-24. 1½ mi se ext.	1- 5-51	2597	1805- 1820	Tar Springs sd; Miss.	P 30	....
		NORTH LOUISIANA—New Oil Pays						
Concordia	Fairview	Sinclair's R. B. Sharp et al 3, Sect. 10-4n-9e	1- 6-51	7030	6448- 6456	.....	F 98; $\frac{1}{4}$″	44.8
Webster	Ada	Carter Oil Co's Bates-Burson 1, Sect. 2-17n-8w	1-18-51	5407	5328- 5332	Anhydrite Stringer li; L. Cre.	F 180; $\frac{3}{16}$″	33
		NORTH LOUISIANA—New Gas Field						
De Soto	.....	E. C. Laster's Perkins & McLaurin 1, (OWWO) C SE SW 25-15n-14w	1-26-51	6645	5110- 5120	Gloyd li; L. Cre.	No gge.	....
		SOUTH LOUISIANA—New Oil Pays						
Beauregard	Hurricane Creek	Magnolia Pet. Co's Doornbos-McPherson N-1, C NE SE 23-5s-8w	12-27-50	14573	14530-14573	Wilcox sd; Eoc.	F 1512; $\frac{5}{16}$″	45.3
Iberia	Avery Island	Humble O&R Co's Petit Anse Co. B-21, Sect. 23-13s-5e	1-27-51	12843	12779-12785	.....	F 641; $\frac{3}{16}$″	32
Terrebonne	Block 72	Magnolia Pet. Co's St. Lse. 768-B-1, Ship Shoal Area, Blk 87	12-28-50	12066	11048-11054	.....	F 510; $\frac{1}{16}$″	37.2
		SOUTH LOUISIANA—Oil Field Extensions						
Jefferson Davis	Iowa	Shell Oil Co's N. O. Denny 1, C NW SW NW 8-9s-6w. ½ mi ne ext.	1- 5-51	10602	10028-10064	Miocene	F 57; ¼″	42.8
Jefferson Davis	Iowa	Shell Oil Co's Iris Leger 1, C SW SE NW 6-9s-6w. ¾ mi n ext.	1- 1-51	11095	10396-10444	Miocene	F 280; $\frac{1}{64}$″	38.5
		MICHIGAN—New Gas Pay						
Mecosta	Paris	Cities Service Oil Co's McFarlane 1, SE NW SE 21-16n-10w	1-23-51	3493	1215- 1222	Stray sd; Miss.	F 1.5 mln.	....
		MISSISSIPPI—New Oil Field						
Adams	.....	Danciger O&R Vo. et al's Geo. W. Armstrong 1-B, Sect. 19-5n-2w	1-17-51	6765	6510- 6526	Barksdale sd; Eoc.	F 108; ⅛″	35.8
		MISSISSIPPI—New Distillate Field						
Forrest	Pistol Ridge	I. P. LaRue Creosote Oil Corp. 1, C SW SE 7-1s-13w	1-23-51	9010	7722- 7726	Tuscaloosa sd; U. Cre.	F 27; 1.7 mlu; $\frac{1}{16}$″	62
		MONTANA—Oil Field Extension						
Pondera	Pondera	Fulton Pet. Co's Miller 2, SW NE NE 11-27n-4w. ½ mi ne extension	1-10-51	1900	1885- 1900	Madison li; Miss.	P 10; 50 wtr	....
		NEW MEXICO—New Oil Pay						
San Juan	Table Mesa	Continental Oil Co's Table Mesa 17, SE SE SW 3-27n-17w	1 15-51	7761	7450- 7492	Ouray li; Devo.	F 144; $\frac{1}{16}$″	52
		NEW MEXICO—Oil Field Extension						
Lea	Bagley	Amerada Pet. Corp's Caudle 2, C NW NW 3-12s-33e. 1 mi w extension	1-19-51	11083	11012-11045	Devonian li; Devo.	F 458; 6 wtr; ½″	44.3
		NEW MEXICO—New Gas Field						
San Juan	Largo Canyon	Sharp Drlg. Co's Bolack-Federal 1, SE NW NW 18-28n-8w	1-14-51	4637	3815- 4637	Cliff House sd; U. Cre.	F 2.5 mln.	....
		NEW MEXICO—Gas Field Extension						
San Juan	Kutz	R. A. & W. G. Johnston's Federal 1, SE NW NW 19-27n-9w. 1 mi se ext.	12- 2-50	2456	2385- 2456	Pict. Cliffs sd; U. Cre.	F 1.6 mln.	....
		OHIO—Oil Field Extension						
Coshocton	New Castle	Jno. Morrow et al's E. O. Rodehaver 1, New Castle Twp. 1 mi ne ext.	1-17-51	3146	3108- 3116	Clinton sd; Sil.	Sw 40	....
		OKLAHOMA—New Oil Fields						
Alfalfa	McWillie, N.	Cecil Davis et al's Glidewell 1, SW SW NE 14-24n-11w	1- 5-51	5935	5790- 5923	Oswego li; Penn.	F 6; 15 wtr	....
Garvin	PaulsValley, W	Cities Service & Ohio Oil Co's Hatcher 1, NW NW NE 28-4n-1w	1-23-51	4740	4674- 4682	2nd Bromide sd; Ord.	F 261; $\frac{11}{64}$″	40.8
Garvin	.....	Max Pray et al's Miller 1 (OWDD), C NW SW 11-4n-4w	1-15-51	8111	7900- 7960	5th Deese sd; Penn.	F 93; 1″	39.7
Garvin	.....	Superior Oil Co's McDaniel 1 (OWWO), C NW SW 15-4n-4w	1- 4-51	12549	8116- 8173	Gibson sd; Penn.	P 70	40.2
Lincoln	N.E. Carney	Wilcox Oil Co's Kinder 1, NW NE SE 28-16n-3e	1-17-51	4860	4780- 4784	Misener sd; Miss.	F 240; ¾″	46
Lincoln	Sparks N.E.	Mid-Continent Pet. Corp's School Ld. 213-1, SE SE SE 29-14n-5e	1- 5-51	4006	3987- 4005	Bartlesville sd; Penn.	P 15	42
Love	Marietta, E.	Walter H. Gant's Liddel 1, NE SW NE 13-7s-2e	1- 2-51	6835	5498- 5510	Deese sd; Penn.	F 108; $\frac{1}{4}$″	40.7
Payne	Mt. Hope, N.	The Texas Co's Real Pitts 1, SE SE NE 30-19n-4e	1-16-51	3949	3644- 3655	Skinner sd; Penn.	F 38; ¼″	6.2
Seminole	.....	Birmingham-Bartlett Drlg. Co's Gragg A-1, SW SE SE 13-11n-7e	1-24-51	3751	3676- 3683	Cromwell sd; Penn.	P 33; 25 wtr	37
		OKLAHOMA—New Oil Pays						
Logan	Marshall, N.	Schermerhorn Oil Co's Bridal 1, NE NE SE 5-19n-4w. 1 mi nne fr prod.	1- 2-51	6420	4744- 4766	L. Layton sd; Penn.	F 72	35
Pottawatomie	Shawnee, E.	Newt Barrett & Grady Musgrove's Guderian 1, SE NE NW 12-10n-4e	1-25-51	4865	4837- 4859	1st Wilcox sd; Ord.	P 456	40
Seminole	Bethel, N.E.	Van-Grisso & R. P. Traugh et al's Reed 1, SE SW SW 19-10n-8e	1- 7-51	4310	4129- 4134	Hunton li; Sil.	F 58; ¼″	37
		OKLAHOMA—Oil Field Extensions						
Creek	Cushing	Warren-Bradshaw et al's Wm. Jones 1 (OWWO), SE NW SW 31-18n-7e. ¾ mi w extension.	1- 7-51	3300	2709- 2711	Red Fork sd; Penn.	F 35; $\frac{21}{64}$″	39
Payne	Yale-Quay	Mid-Continent Pet. Corp's Ira B. Minnick 1, NW NW NW 19-19n-6e. ½ mi s extension.	1-11-51	3086	2604- 2614	Cleveland sd; Penn.	P 20; 12 wtr	38
Seminole	Cheyarka, S.W.	Deardorf Oil Co's Lujan 1, NE NE NW 6-9n-7e. ½ mi n ext.	1- 4-51	3725	3713- 3725	Gilcrease sd; Penn.	P 50	....
Stephens	Doyle, N.E.	Bay Pet. Co's Payne 1, SW SW SW 1-1n-5w. ½ mi nw ext.	1- 4-51	8372	6715- 6845	Deese sd; Penn.	F 478; $\frac{1}{16}$″	40
		OKLAHOMA—Distillate Field Extension						
Logan	Marshall	Trigg Drlg. Co's Pollard 1, NE NE SE 6-18n-4w. ½ mi s ext.	1-19-51	6390	4674- 4686	L. Layton sd; Penn.	F 1; 1 mln; $\frac{3}{32}$″	....
		OKLAHOMA—New Gas Pay						
Carter	Scholem Alechem	Magnolia Pet. Corp's Ida Bumpass 7, C NW SE 33-1s-3w	1- 8-51	10900	5222- 5522	Simpson sd; Ord.	F 6.5 mln.	....
		OKLAHOMA—Gas Field Extension						
Lincoln	Peck, S.	Davon Oil et al's Lucy Adams 1, NW SW NE 5-13n-6e. ½ mi nw ext.	1-21-51	3183	3110- 3120	Prue sd; Penn.	F 3.5 mln; open	....
		TEXAS—District 1 (SOUTH CENTRAL)—New Oil Fields						
Atascosa	"Coughran"	Lone Star Gas Prod. Co's Sarah E. Ferry 1, Sect. 1699, I&GN Sur.	12-28-50	8280	8208- 8230	Edwards li; L. Cre.	F 128; $\frac{3}{16}$″	33
Bexar	.....	Pegg Bros. Drlg. Co's Pablo Verdeja 2, N. Montaya Sur.	1-15-51	853	840- 853	.....	P 2	....
Frio	"Hindes"	Milam Drlg. Co's W. L. Pickens 1, Austin & Williams Sur.	1- 9-51	5620	5608- 5620	.....	P 74	35.5

Use BREWSTER *Drawworks.*

To see you through 'till '62—and longer.

Brewster rigs will see you through the years ahead with cheaper drilling to any depth.

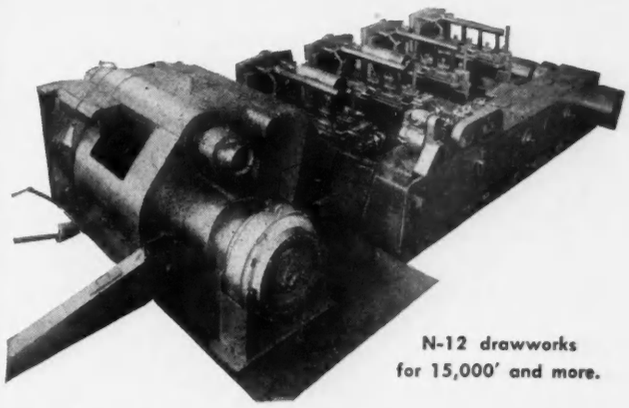
DESIGNED FOR HARD WORK—BUILT TO LAST

You can drill fast with them—haul 'em around—rig up in a hurry—and get miles of hole without a lot of maintenance work or replacement of parts.

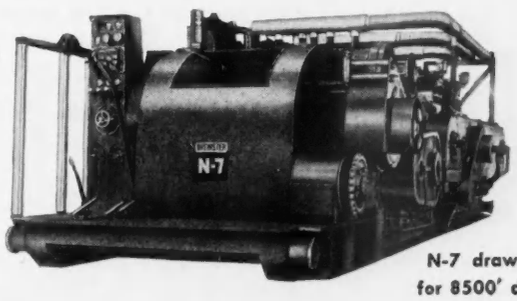
They're tough. They have big bearings—big shafts—big bolts—big cap screws and heavy plate housings. The rigid frames hold shafts in alignment even with rough treatment—and the careful balancing of parts reduces vibration. Oil circulation systems on the larger rigs assure complete lubrication and cooling. *That's why Brewster rigs will see you through 'til '62—and longer.*

Watch for the announcement
of Brewster's newest drawworks for 6,000' drilling

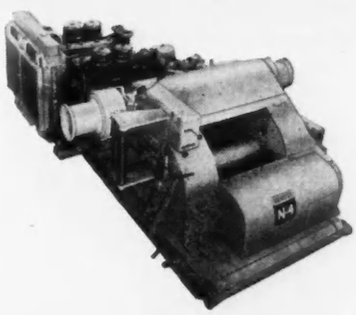
—and Brewster rigs use standard makes of replacement parts, available in a hurry from your own supply store or from Brewster's large stock.



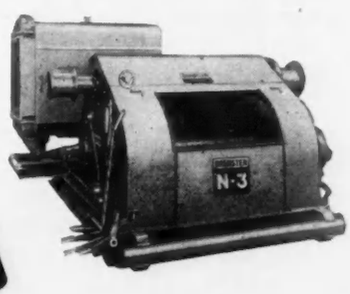
N-12 drawworks for 15,000' and more.



N-7 drawworks for 8500' drilling.



N-4 drawworks for 5000' drilling.



N-3 drawworks for 3500' drilling.

Ask these supply companies for Brewster drilling equipment:

Apex Equipment Company
Bovaird Supply Company
Industrial Supply Company
Murray Brooks, Inc.
Reams Supply Co.

In Canada: **Rocky Mountain Supply Co.**
Direct and through recognized export dealers.

Write today for the new pocket size catalog, giving full details on Brewster Drilling Equipment.

BREWSTER DRILLING EQUIPMENT

Manufacturers of drilling equipment since 1910

THE BREWSTER COMPANY, INC., SHREVEPORT, LA.

New Oil, Distillate and Gas Fields, and New Pay Horizons Discovered in United States in January, 1951

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
Williamson		H. J. Stewart's Anna Rieger 1, Peter Cartwright Sur.	12-21-50	960	942- 960	Serpentine sd; U. Cre.	P 7	38
		TEXAS—District 2 (MIDDLE GULF)—New Oil Fields						
Goliad		Magnolia Pet. Co's Wilkinson Estate 5, Wm. P. Miller Sur.	1-15-51	3280	3207- 3209		F 73; 1/8"	20.9
Victoria		Kirby Pet. Co's R. T. Buchanan et al 1, Sect. 7, Indianola RR Sur.	1-23-51	8517	8157- 8162	Wilcox sd; Eoc.	F 274; 1/4"	33
		TEXAS—District 2 (MIDDLE GULF)—New Oil Pay						
Victoria	McFaddin, E.	Union Prod. Co. et al's McFaddin A-25, Maria J Traviesa Sur.	1- 3-51	6051	5900- 5906		F 153	41
		TEXAS—District 2 (MIDDLE GULF)—New Distillate Fields						
Calhoun		Quintana Pet. Corp's Jamie Hynes 1, J. F. de la Fuentes Sur.	12-11-50	9867	7789- 7795		F 785; 10.2 mln.	58.2
Goliad	"Gladys Powell"	Frank W. Michaux' Kauffman Est. 1, Geo. Sutherland Sur.	1- -51	8029	7832- 7844	Eocene	F 242; 5.4 mln; 1/4"	58.1
		TEXAS—District 2 (MIDDLE GULF)—New Gas Fields						
Bee		Bridwell Oil Co's J. S. Hall 1, Anne Burke Sur.	12-15-50	4473	3700- 3703		F 12.8 mln; 3/16"	
Jackson	N.W. Bennview	Caroline Hunt Tr's Josef Pecha 1 (OWWO), V. Garcia Gr.	1-26-51	7012	6102- 6108		No gge.	
Jackson		J. M. Huber Corp's William Classen 1, James Kerr Sur.	1- 3-51	3359	2806- 2810		F 6 mln; open	
Victoria	"De Pine"	Miller Wells Corp's Josephine & Adela de Pine 1, Jno. D Wright Sur.	12- 4-50	5310	3950- 3952		F 37 mln; open	
		TEXAS—District 3 (UPPER GULF)—New Oil Field						
Harris		Commercial Pet. & Transport Co's Herbert S. Crawford Unit 1, (OWWO), Christian Smith Sur.	12-10-50	8520	6362- 6367		F 179; 3/64"	29.5
		TEXAS—District 3 (UPPER GULF)—New Oil Pays						
Colorado	Sublime	Tide Water Assoc. Oil Co's W. F. Albert 1, (OWWO), T. J. Evans Sur.	12-30-50	9540	8526- 8532		F 100; 11/64"	41.8
Jefferson	Spindletop	Stanolind O&G Co's Gladys City Oil & Mfg. Co. 107-B, Jno. Veatch Sur.	1-13-51	5190	4766- 4800	Heterostegina li; Olig.	P 96; 2 wtr	29
Wharton	Lakeview-Hutchins	W. A. Clarke, Jr's Ustynik 1, Sect. 14, I&GN Sur.	12-30-50	5777	3962- 3968	Frio sd; Clig.	P 49	26
		TEXAS—District 3 (UPPER GULF)—New Distillate Field						
Wharton		R. E. Hibbert's Valigura 1, Thos. Slaughter Sur.	12-30-50	8550	7623- 7672		F 90; 3 mln; 7/32"	55
		TEXAS—District 3 (UPPER GULF)—Distillate Field Extension						
Hardin	Village Mills	Wood Pet. Co's Gulf Oil Corp. Fee 1, J. Buckman Sur. 1 mi sw ext.	12-26-50	9510	8926- 8963	Wilcox sd; Eoc.	F 227; 7.3 mln; open	56.6
		TEXAS—District 3 (UPPER GULF)—New Gas Fields						
Wharton		H. C. Cockburn's W. D. Winn 1, S. Castleman Sur.	1-24-51	5557	4184- 4188	Miocene sd; Mio.	F 16 mln; open	
Wharton		Kingwood Oil Co's Lacy W. Armour et al 2, Chas. Howard Lge.	1-10-51	6839	5301- 5308		F 22 mln; open	
		TEXAS—District 3 (UPPER GULF)—New Gas Pay						
Liberty	N. Dayton	Corley & Geiselman et al's Paraffine Oil Co. 1, Edmond Pruitt Sur.	1-16-51	8520	8110- 8120		F 10.6 mln; open	
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Fields						
Webb	"Tal Vez"	Clardy & Barnett's O. C. Kirkpatrick 1, CCSD&RGNGRR Sur.	12-28-50	2350	2295- 2300	Bruni sd; Eoc.	P 22	40.8
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Pays						
San Patricio	Sinton	Billy Bridewell & W. G. Darsey, Jr's S. J. Lewis 1, (OWWO), M. J. de la Garza Sur.	1-27-51	5312	5082- 5090	Frio sd; Clig.	F 95; 11/64"	34.6
San Patricio	Welder-Durham	Seaboard Oil Co. of Dela's R. H. Welder 4, Sect. 38, E. H. Welder Reh Subd.	1-16-51	6150	6146- 6150		F 139; 3/32"	22.9
Starr	Sun, N.	Bass & Vessels' Arturo Pena Hrs. 1, Santa Teresa Gr.	1-11-51	6001	5535- 5541	Frio sd; Olig.	F 53; 1/8"	43.6
		TEXAS—District 4 (LOWER GULF-S.W.)—New Distillate Fields						
Hidalgo		L. M. Lockhart's 1st Natl. Bk of Chicago 1, Lot 11, Blk 3, Alamo Ld. & Sugar Co. Subd.	1-15-51	8975	8510- 8526		F 244; 6.9 mln; open	
San Patricio		Phillips Pet. Co's Turk 1, State Lse 30398, Jno. Smith Sur.	1- 3-51	9644	9480- 9550		No gge.	
		TEXAS—District 4 (LOWER GULF-S.W.)—New Distillate Pay						
Duval	Eagle Hill	Ralph E. Fair-Woodward & Co's J. R. Foster 1, Chas. Adami Sur.	1-22-51	7892	7116- 7336	Wilcox sd; Eoc.	F 242; 10 mln; open	55
		TEXAS—District 5 (EAST CENTRAL)—Oil Field Extension						
Kaufman	Walter Fair	Murphy Corp's Lumpkin 1, B. S. Newman Sur. 1/2 mi sw ext.	1-26-51	4950	4940- 4950	Paluxy sd; L. Cre.	P 144	31
		TEXAS—District 6 (NORTHEAST)—New Oil Fields						
Red River		Busbee Lbr. Co's Sam Busbee 1 (OWWO), Benjamin Gooch Sur.	1-10-51	1820	1814- 1820		P 3	31
		TEXAS—District 6 (NORTHEAST)—Distillate Field Extensions						
Harrison	Woodlawn	Stanolind & Continental Oil Co's G. H. Sanders 1, S. F. Sparks Sur. 1 mi n extension.	12-29-50	6561	6378- 6460	Pettit li; L. Cre.	F 984; 195 mln; open	72
Marion	Rodessa	Arrow Drlg. Co's Sharp Hrs. 1, Charles Grayson Sur. 3/4 mi e ext.	12-20-50	6060	5752- 5762	Rodessa li; Cre.	F 25; 22.5 mln.	
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Fields						
Concho		C-B Drilling Co. et al's Walter Pfluger 1, A. Sator Sur. 2088.	1-29-51	2141	2121- 2124	Strawn sd; Penn.	F 102; 2"	34
Runnels		Bishop Oil Co's M. J. Adams 1, Sect. 13, Blk 129, C. D. Skidmore Sur.	1-10-51	4401	4385- 4401	Fry sd; Penn.	F 606; 1/2"	42
Runnels		G. B. Cree's Myrtle Allen 1, Sect. 9, HT&B Sur.	12-18-50	4201	3855- 3859	Gardner sd; Penn.	F 264; 1/4"	41.2
Runnels		J. K. Dobb's E. D. Freeman 1, D. Moses Sur.	12-28-50	3999	3979- 3990	Gardner sd; Penn.	F 215; 1/2"	40.9
Runnels		Jim Murrey et al's I. W. Rogers 1, E. Mather Sur.	1-22-51	4124	4088- 4090	Gardner sd; Penn.	F 156; 3/32"	46.9
		TEXAS—District 7-C (WEST CENTRAL)—Oil Field Extensions						
Upton	Pembrook	Havenstrite Oil Co's Ralph Pembrook 1, Sect. 2, Blk. OELRR Sur. 1/2 mi n extension	1- 9-51	7177	7144- 7177	Spraberry sd; Perm.	F 183; 5/8"	37
Upton	Pembrook	Havenstrite Oil Co's Pembrook-Beal 1-1, Sect. 1, Blk X, De Witt Sur. 1 1/4 mi se extension.	1-18-51	7030	6965- 7030	Spraberry sd; Perm.	F 380; 5/8"	39
		TEXAS—District 7-C (WEST CENTRAL)—New Distillate Field						
Schleicher		Westbrook Oil Corp's A. L. Baugh 1-A, Sect. 8, Blk M, GH&SA Sur.	1-17-51	5790	5728- 5758	Strawn sd; Penn.	F 13; 3.2 mln;	69
		TEXAS—District 8 (WEST)—New Oil Fields						
Crane		Humble O&R Co's Hallie C. Day 1, Sect. 15, Blk X, CCSD&RGNG Sur.	1-17-51	8674	8606- 8645	Devonian li; Devo.	F 111; 1/4"	43.5
Crane		Placid Oil Co's A. R. Eppenauer 1, Sect. 14, Blk 6, H&TC Sur.	1- 2-51	3001	2710- 2730	San Andres li; Perm.	F 134; 3/8"	38
Dawson		Sunray Oil Corp's Robert Brown 1, Sect. 3, Blk 35, T-4-N, T&P Sur.	1-13-51	9538	9496- 9524	Canyon Reef li; Penn.	F 302; 2/8"	42
Midland		Bernett & Sweeney's Ben Winkleman A-1, Sect. 18, Blk. 37, T-3-S, T&P Sur.	1-24-51	8695	7937- 8077	L. Spraberry sd; Perm.	F 59; 7/64"	42
Midland		Ted Weiner et al's J. W. Driver 1-16, Sect. 16, Blk. 37, T-4-S, T&P Sur.	1-26-51	7325	7110- 7325	Spraberry sd; Perm.	F 303; 1/2"	37.1
Pecos		C. H. Murphy & Co's Maude E. Ford 2, Sect. 3, Blk. 3, H&TC Sur.	1-14-51	6076	5175- 5183	McKee sd; Ord.	F 336; 1/4"	43
		TEXAS—District 8 (WEST)—New Oil Pays						
Ector	Jordan	Sinclair O&G Co's W. E. Connell Tr. C-5, Sect. 10, Blk. 16, PSL Sur.	1- 5-51	8916	8375- 8415	Waddell sd; Ord.	F 248; 1/4"	43.8
Midland	Parks	Magnolia Pet. Co's H. S. Collings 1, Sect. 7, M. Daugherty Sur.	1- 4-51	13302	10375-10425	Pennsylvanian sd; Penn.	F 567; 7/16"	34.7
		TEXAS—District 8 (WEST)—Oil Field Extensions						
Gaines	Harris	The Texas Co's Laura Elam 1, Sect. 14, Blk. A-22, PSL Sur. 1 mi n ext.	1- 9-51	5950	5910- 5935	Glorietta li; Perm.	P 124	30.6
Glasscock	Tex-Harvey	York & Harper, Inc's K. S. Boone 1, Sect. 17, Blk. 36, T-3-S, T&P Sur. 3/4 mi n extension.	1-11-51	7135	6870- 6930	Spraberry sd; Perm.	F 530; 1/2"	38
Sterling	Durham	N.R.C. Oil Co. & Joe G. Sauer's E. F. Fisher 1, Sect. 18, Blk 12, SPRR Sur. 1/2 mi e extension.	1-29-51	1449	1398- 1449	San Andres li; Perm.	P 9	31.4
		TEXAS—District 8 (WEST)—New Gas Fields						
King		Stanolind O&G Co's R. B. Masterson 11, Sect. 68, Blk A, Jno. B. Rector Sur.	1-12-51	5430	5390- 5393	Strawn sd; Penn.	F 0.6 mln open	
Pecos		Callery & Hurt's Eaton A-1, Sect. 27, Blk 3, H&TC Sur.	1- 2-51	8061	5324- 5470	U. Montoya sd; Ord.	No gge.	
		TEXAS—District 10 (PANHANDLE)—New Oil Field						
Grey		Phillips Pet. Co's Wheat 1, Sect. 5, Blk C-2, CCSD&RGNG Sur.	12-10-50	2868	2799- 2825	Permian li; Perm.	P 114	
		TEXAS—District 10 (PANHANDLE)—New Gas Field						
Gray		Phillips Pet. Co's Wheatley 1, Sect. 3, Blk C-2, CCSD&RGNG Sur.	12-20-50	2871	2833- 2870	Permian li; Perm.	F 6 mln	
		WYOMING—New Oil Field						
Big Horn	Bonanza	Bonanza Oil Co's Gov't. 1, C SW NE 26-49n-91w.	1- 2-51	2528	2478- 2528	Tensleep sd; Penn.	F 258; 1/8"	
		WYOMING—New Oil Pay						
Converse	Big Muddy	Southern Prod. Co's Smith-Anderson 1-E, C NW NW 1-33n-76w. 1 mi ne of production.	1-14-51	4980	4773- 4780	Muddy sd; U. Cre.	F 550	
		WYOMING—New Gas Pay						
Johnson	Meadow Crk.	Continental Oil Co's Unit 33, NW NE SW 2-41n-78w.	1-25-51	4268	4227- 4268	Shannon sd; U. Cre.	F 5 mln; 3/4"	

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovivian; Cam, Cambrian.

[2] Barrels of oil per day 24 hour rate), flowing, (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.

Current Problems

Of the Drilling Contractor

By

A. W. THOMPSON

President, Thompson-Carr, Inc.

and

President, American Association of Oilwell Drilling Contractors

FACING A larger order of wells and footage to be drilled in 1951 than ever before, the drilling contractors must consider possible material and manpower shortages as deterrents to their performance of the record-breaking task of accounting for approximately 89 percent of all wells to be drilled during the year. With equipment, labor and operating costs soaring, the contractor must also strive to make an outmoded rate per foot absorb all the increases and still provide a backlog for equipment replacement. This survey, highlighting the contractor's status at the outset of what will probably be his busiest year, was presented by the author before the Dallas Petroleum Engineers Club February 23.

THE petroleum industry faces the tremendous task of supplying enough oil to meet rapidly rising consumption and at the same time to create additional producing ability to satisfy any sudden increase that would come should intensive warfare result from present troubled international affairs. A large portion of this burden falls on the industry's drilling operations, and therefore upon drilling contractors.

Because time constantly is taking its toll of producing wells, it is axiomatic that to have enough oil a sufficient number of new wells must be drilled each year. Not only must new wells be completed to offset declining production of old wells, but also to provide increased producing capacity to satisfy rising petroleum requirements and all possible future military needs.

All signs presage greater quantities of petroleum will be needed in 1951 than ever before. It is indicated that U. S. oil consumption this year will be at least 400,000 barrels per day greater than the record volume attained in 1950. So rapid is the growth in consuming rates that 1951 demand is expected to be two-thirds greater than in 1941 and nearly 50 percent above 1945. To supply enough production to fulfill this enlarged need, it is essential that a record-breaking number of wells be drilled in 1951.

A tentative program for the drilling of a minimum of 44,000 wells during 1951 has been established by the

Petroleum Administration for Defense. While this represents only 800 more wells than were completed in 1950, it far exceeds any other preceding year. For example, this drilling rate would be nearly 5000 wells above the previous peak of 39,477 drilled in 1948, and in contrast with the prewar peak of 32,510 wells in 1941.

More important than the number of wells to be drilled is the amount of footage required, as footage drilled is more directly related to equipment needs than wells and also to the time a rig may be tied up drilling one hole. It takes much less equipment and time to drill a shallow hole than a deep one. Therefore, it is significant to note that footage is increasing more rapidly than the number of wells drilled. It is forecast that 170 million feet of hole will be drilled in 1951, compared with 160 million in 1950, with 93 million in 1945 and 99 million in 1941.

Footage is increasing more rapidly than the number of wells because a larger portion of the operations are concentrated in deeper producing areas, such as Texas, Louisiana and Oklahoma. Consequently, the average depth per well in the U. S. has increased from 3056 feet in 1941 to 3489 feet in 1945, and to 3689 feet in 1950.

The foregoing figures indicate the growing development burden which is being thrust upon the petroleum industry, much of which falls on contractors because they are steadily performing a greater percentage of the drilling. Contractors today drill 20 percent more of the wells than they did 15 years ago. Whereas, only 68 percent of the wells were drilled by contractors in 1935, contractors drilled 71 percent in 1940, 80 percent in 1945, and 88 percent in 1950.

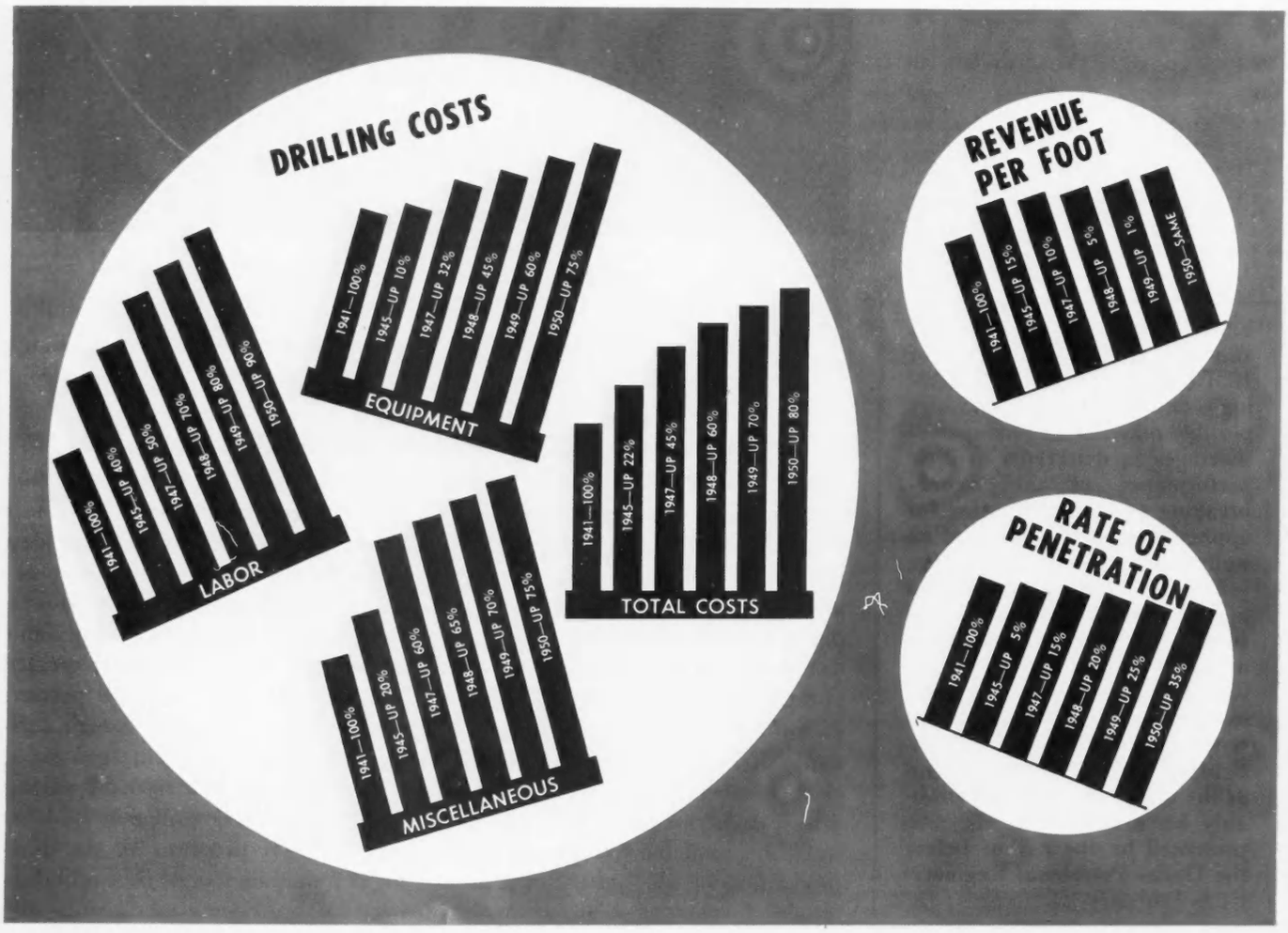
1951 Outlook

The long steady growth in contract drilling indicates contractors should do about 89 percent of the drilling in 1951. On this basis, contractors must drill at least 39,160 wells and approximately 150 million feet of hole if a minimum of 44,000 wells is to be completed this year. This will represent a very sharp increase over the volume of drilling done by contractors in previous years, the footage figure being double that of 1945 and 1941. It is indicated that in 1948, when contractors were doing 82 percent of the drilling, they accounted for the completion of 32,371 wells and 112 million feet of hole; but in 1945, when performing only 80 percent of the drilling, contractors drilled an indicated 21,319 wells and 75 million feet of hole; and in contrast drilled 23,407 wells and 71½ million feet of hole in 1941 when doing 72 percent of the drilling.

The drilling of 44,000 wells in the U. S. this year means that the nation's approximately 5000 rigs of all kinds must drill an average of nearly nine wells each, or one well per rig every 5¾ weeks. When time for moving and rigging up is considered, less than 35 days will be available as an average for actual drilling operations per well.

Exclusive of 150 part-time and company-contractor combinations, there are 1650 active drilling contractors in the U. S., of which 850 are rotary contractors and 800 cable tool contractors. Contractors own 4500 rigs, of which 3200 are rotary and 1300 are cable tool, according to the American Association of Oilwell Drilling Contractors.

U. S. Drilling Costs Trends



At today's value the investment in contract drilling rigs probably is in the neighborhood of $350 million.

In drilling approximately 150 million feet of hole, drilling contractors will do a gross business of about $900 million this year. Although this represents a lot of business, failure of drilling prices to keep pace with increased costs has placed the drilling contracting business in an unhealthy economic condition in recent years.

Sharp increases in costs during the past year, coupled with previous gains since the end of World War II, make present drilling operations far more costly than prewar levels. Yet contractors are receiving exactly the same rate of revenue for their work as they did in 1941.

For the U. S., as a whole, total or over-all daily drilling costs for rotary rigs are now 75 percent greater than in 1941 and 53 percent higher than in 1945. In contrast, drilling contractors' revenue per foot of hole drilled is the same as in 1941 and 15 percent less than in 1945.

Drilling contractors to some extent—but only partially—have been able to offset growing costs by increased efficiency. The average rate of penetration or speed of making hole today is about 35 percent faster than in 1941 and 30 percent greater than in 1945.

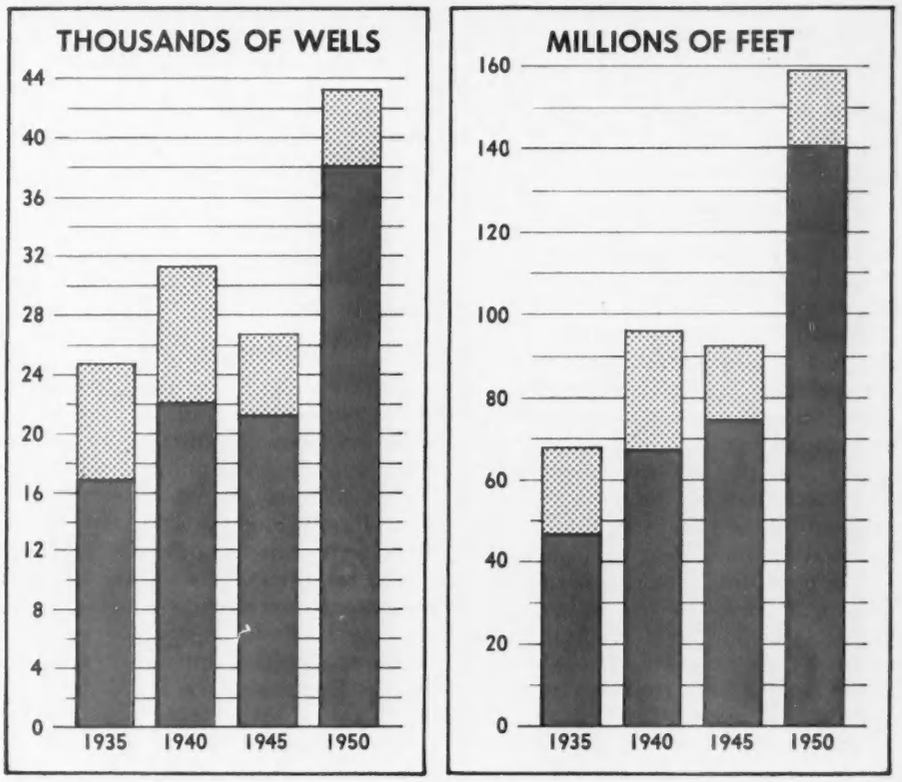
Unless the relationship between costs and revenues improves, the efficiency of the drilling business will deteriorate because contractors will be unable to make the large investments necessary in purchasing modern equipment, nor will they be able to maintain existing equipment in A-1 condition. The inevitable result over a long period of time would be the liquidation of physical assets into cash, and drilling equipment will become obsolete and worn out.

Major factors in the trend toward increased drilling costs are (1) higher costs of wages, equipment and operating expenses; (2) greater depth of wells; and (3) the larger proportion of exploratory or wildcat wells being drilled.

Labor costs on rotary rigs, which account for approximately one-third of the expense of drilling a well, in 1950 were 90 percent above 1941 levels and 50 percent higher than in 1945. This increase is not due to wage rates entirely, as the contractors today are required to perform many additional services.

Equipment costs today are 75 percent above 1941 levels. This is an important increase to the drilling contractor, since equipment expense accounts for about 45 percent of all drilling expenditures.

U. S. Drilling Activity Trend



Solidly colored area indicates portion of total drilling done by contractors.

A large portion of the drilling equipment is of an expendable nature and must constantly be replaced. Bits, drill pipe, drill collars, wire lines and chains fall into this category. These items run into heavy expense. For example, domestic sales of drill collars alone during the past two years totaled 465,000 lineal feet and represented an investment of nearly $14 million.

Constant Replacement

In addition, there must be constant replacement of many other drilling rig parts to keep them in operating condition. Some domestic sales during the past two years have included more than 1800 mud pumps, 772 rotary tables, 760 traveling blocks and 850 swivels.

Miscellaneous expenses have increased sharply, due to greater moving costs, longer time in getting on the job, more complete insurance coverage, and a dozen other expense services incidental to oil well drilling. In contrast with 1941 levels, miscellaneous expenses today are 75 percent higher.

With more of the rotary drilling concentrated in deep areas, increased depth is a factor contributing heavily to higher costs. Despite faster drilling speed, it still costs about 2½ times as much to drill a 10,000-foot well as a 7000-foot well, and a 14,000-foot well is nearly six times more expensive than one of half that depth. The biggest single factor which causes costs for deep drilling to soar is time. Below 7000 feet, making hole becomes progressively slower. Much more of the time is required for non-hole-making operations, such as round trips with the drilling string and surveys of the hole.

Some of the increased costs being experienced by contractors are due to the greater number of wildcat wells being drilled. During 1950 wildcats constituted 18 percent of all the wells completed in the U. S., whereas only 14.8 percent were wildcats in 1945, and but 10.5 percent in 1941. Wildcats cost much more than field wells due to the greater amount of coring and survey work required, and because of the delay born of caution necessary when little is known about formations to be penetrated.

An exceedingly important question in the program to drill 44,000 wells this year is whether drilling operations will be seriously disturbed by shortages of steel and skilled workers.

To drill a larger number of wells more steel will be needed, and this will not be easy to obtain under the nation's expanding armament plans. Steel must be forthcoming to sustain the industry's drilling operations. The great deal of attention being given this problem lends encouragement

that the petroleum industry will receive its fair share of the available supply for critical industries.

Highly significant was the action of National Production Authority in late January of allocating 1,890,000 tons of oil country tubular goods to the Petroleum Administration for Defense. This is sufficient steel to drill 44,000 wells during 1951.

This is an important step, but still leaves many problems to be resolved. While most of the oil industry's complaints on steel shortages so far have dealt with tubular goods, other items are just as important in the drilling picture. The drilling contractor needs bits, drill collars and other machinery and tools just as badly as tubular goods. As the country's armament program expands, supplies will not be as plentiful, so shortages of materials will become increasingly noticeable in the near future. This will be particularly true of items requiring nickel, cobalt, stainless steel, tungsten and other alloy metals. Unfortunately, many drilling tools require these hard metals, and unless alloys are available contractors will be forced to use inferior equipment. This condition could greatly increase the contractor's problems, creating a substantial increase in the time required to drill a hole.

Therefore, it will be necessary that the drilling industry receive allocations for steel covering other items than tubular goods. Present plans do not call for inauguration of a controlled materials plan before the beginning of the third quarter. This is a vast undertaking, and cannot be achieved before that time. Meanwhile, confusion and difficulties are likely to increase for the contractor.

Distribution Problem

Another phase that needs resolving is the establishment of fair and equitable methods for distributing available supplies, including procedures which will assure materials for wells actually drilling and prevent materials going where they are not currently required. Only in this way can the most efficient use be made of the steel available for the industry.

These problems apparently will rest in capable hands. The Petroleum Administration for Defense now is being actively organized with highly competent and experienced industry men at the helm.

Another encouraging development is the establishment of PAD as an independent agency responsible only to the Secretary of the Interior. This order clarifies the confusion which has existed over the independent status of PAD and greatly strengthens the authority of PAD.

Availability of skilled manpower, as well as steel, will determine how well drilling contractors are able to meet the burdens now being thrust upon them during the present national crisis.

Skilled manpower is just as essential in providing adequate oil supplies as steel. Yet, to date little attention has been given to establishing regulations which will prevent the loss of trained men. With mobilization henceforth to be at an accelerated pace, manpower could easily become acute for the drilling contractor. During World War II many skilled men left drilling rigs to work in shipyards, plane and munition plants. There were indifferences during the early stages of World War II toward holding the oil industry's skilled manpower, and too many trained men drifted to other defense industries. It is hoped that this time oil from the very beginning will receive the same consideration with reference to military deferment as is given to other critical industries.

Some of the current problems of the drilling contractor have been outlined. There are many more not mentioned. During the past ten years a great deal of progress has been made by the manufacturers in furnishing more efficient equipment. It would be only proper to mention also the assistance the contractors have received from the engineers of the operators' staffs. They have given the drilling industry the benefit of their technical knowledge, and this combined with the practical experience of our drilling crews has enabled us to increase our rates of penetration well above the average of 1941. We in the drilling industry sincerely hope this fine cooperation continues between the contractor and the other related services that are necessary to the drilling industry. The drilling contractor has a service to sell, and to continue in business, every means at his disposal must be utilized to operate efficiently and economically.

In conclusion oil is a major necessity in peace or war and the drilling contractor is an essential link in the vast chain of activities of this great industry. Skilled manpower, efficient machinery, and proper materials are a must to do the job.

U. S. Contractor Drilling Trends

YEAR	Total New Wells Completed	Total Footage Drilled	Average Depth Per Well	Indicated Work by Contractors		
				Percent	New Wells Completed	Footage Drilled
1935	24,851	67,844,939	2,760	68	16,899	46,134,559
1936	28,962	80,996,816	2,797	69	19,984	55,887,803
1937	35,213	105,099,189	2,985	71	25,001	74,620,424
1938	29,127	90,585,158	3,110	71	20,680	64,315,462
1939	28,012	85,523,094	3,053	70	19,608	59,866,166
1940	31,149	96,182,605	3,088	71	22,116	68,289,650
1941	32,510	99,347,714	3,056	72	23,407	71,503,354
1942	21,990	67,903,053	3,088	70	15,393	47,532,137
1943	20,349	61,991,857	3,046	75	15,262	46,493,893
1944	25,786	84,378,457	3,272	78	20,113	65,815,196
1945	26,649	92,982,113	3,489	80	21,319	74,385,690
1946	30,230	101,124,813	3,345	81	24,486	81,911,099
1947	33,147	112,816,124	3,404	81	26,849	91,381,060
1948	39,477	136,709,153	3,463	82	32,371	112,101,505
1949	38,962	138,616,941	3,558	85	33,118	117,824,400
1950	43,204	159,393,997	3,689	88	38,020	140,266,717

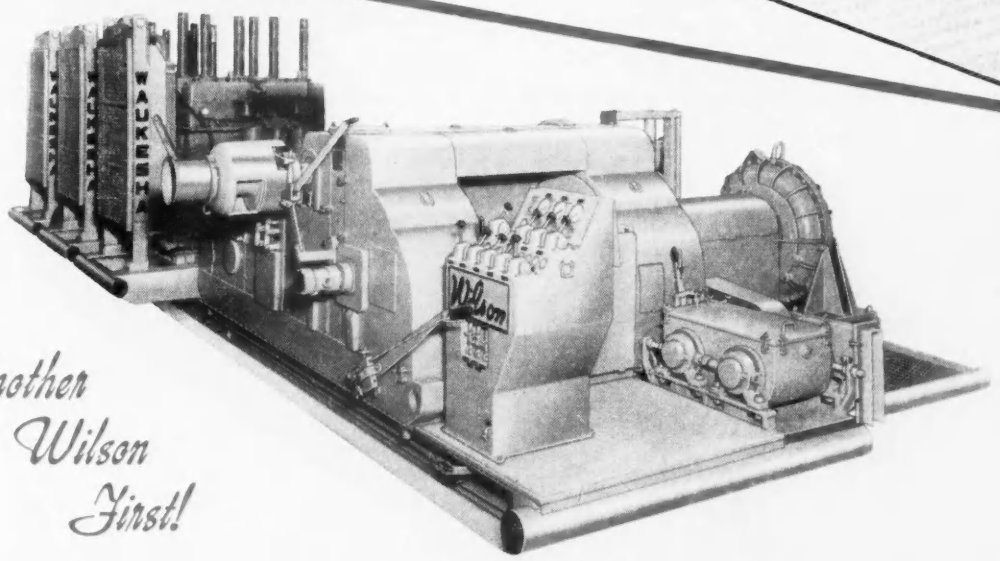
Completions, Footage and Average Depth from WORLD OIL, February 15, 1951 issue.
Percent of work by Contractors from American Ass'n of Oilwell Drilling Contractors.

Trends in Drilling Costs and Revenue

(Recent Years Compared with 1941 Level)

	1941	1945	1947	1948	1949	1950
Drilling Costs:						
Labor	100%	140%	150%	170%	180%	190%
Equipment	100%	110%	132%	145%	160%	175%
Miscellaneous	100%	120%	160%	165%	170%	175%
Total Costs	100%	122%	145%	160%	170%	180%
Revenue per Foot Drilled	100%	115%	110%	105%	101%	100%
Rate of Penetration	100%	105%	115%	120%	125%	135%

Compiled by Engineering Staff—American Ass'n of Oilwell Drilling Contractors.



Another Wilson First!

The all new WILSON TORCAIR-ROADAIR RIG — the world's first rig to be designed for TORQUE CONVERTER DRIVE OR DIRECT ENGINE DRIVE. Completely new — from front to rear. It can be transported in one unit, or can be broken down into several smaller units. It contains Wilson Air-Tube Disc Clutches throughout, Full Pressure Water Cooled Brakes, and many other outstanding features, including the sensational Wilson Sectional Box Type Compound. The only rig with four Air Clutch Speeds on the Drum that can be changed while running — and under any load.

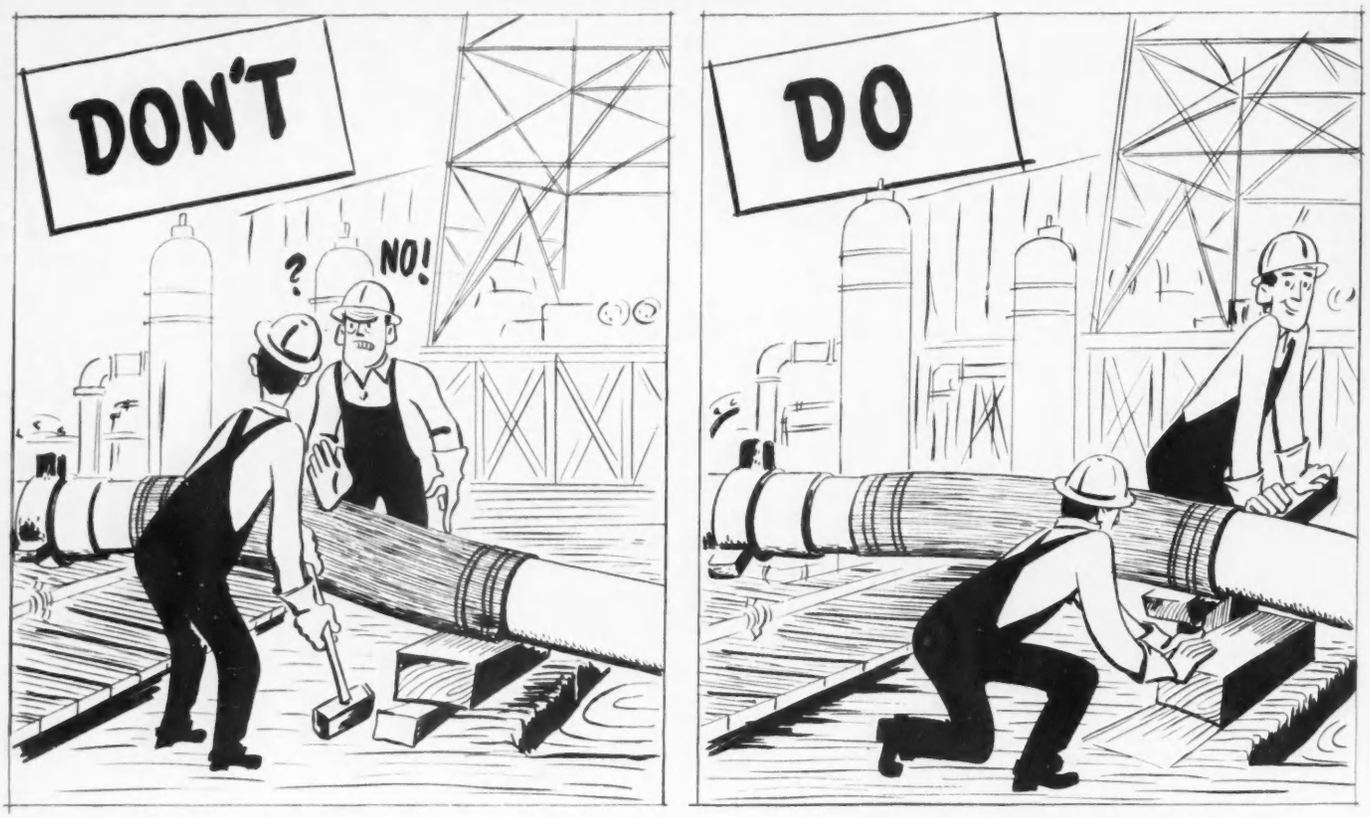
COMPARE PRICES BEFORE YOU BUY!

SEE YOUR NEAREST WILSON DISTRIBUTOR or WRITE FOR BULLETIN 180

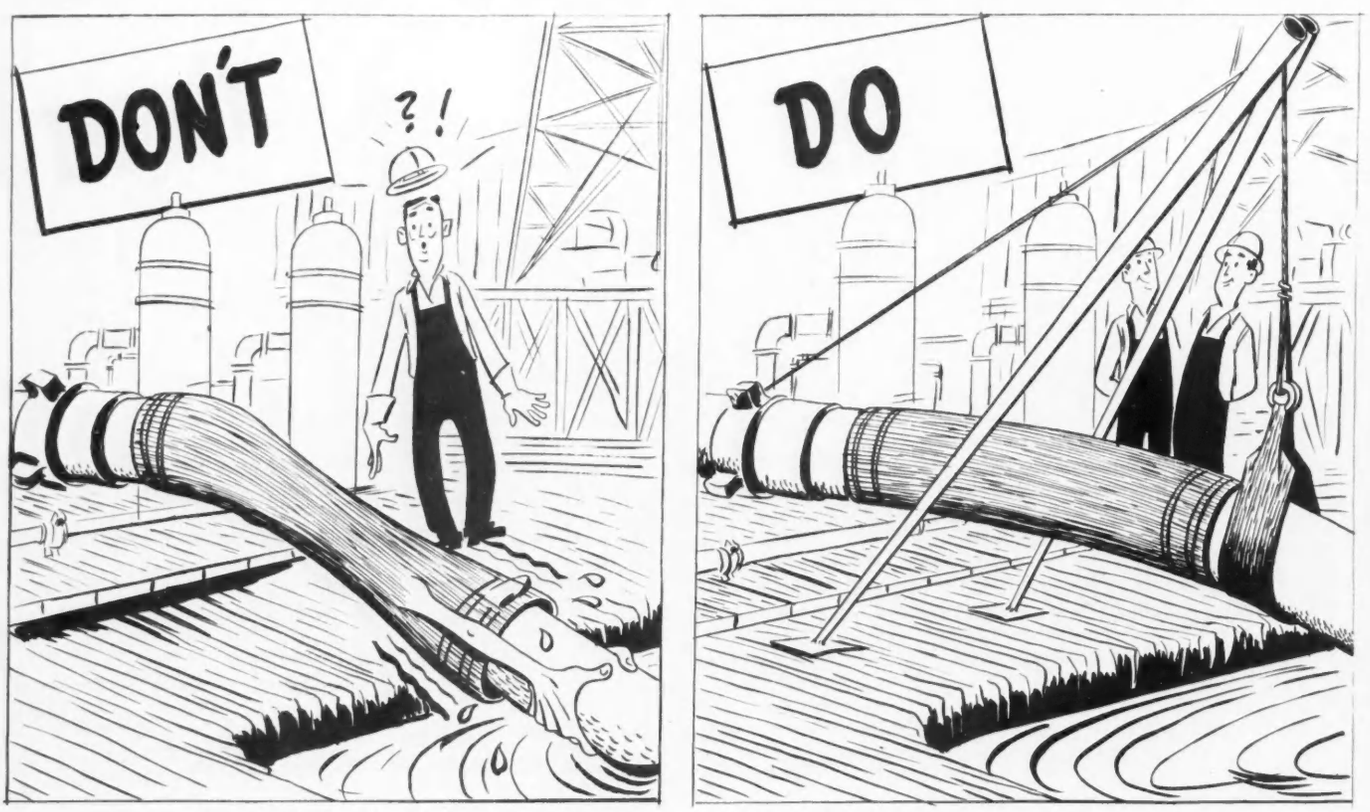
Wilson MANUFACTURING CO., Inc.
WICHITA FALLS, TEXAS

World Oil Graphics

SUCTION HOSE CARE

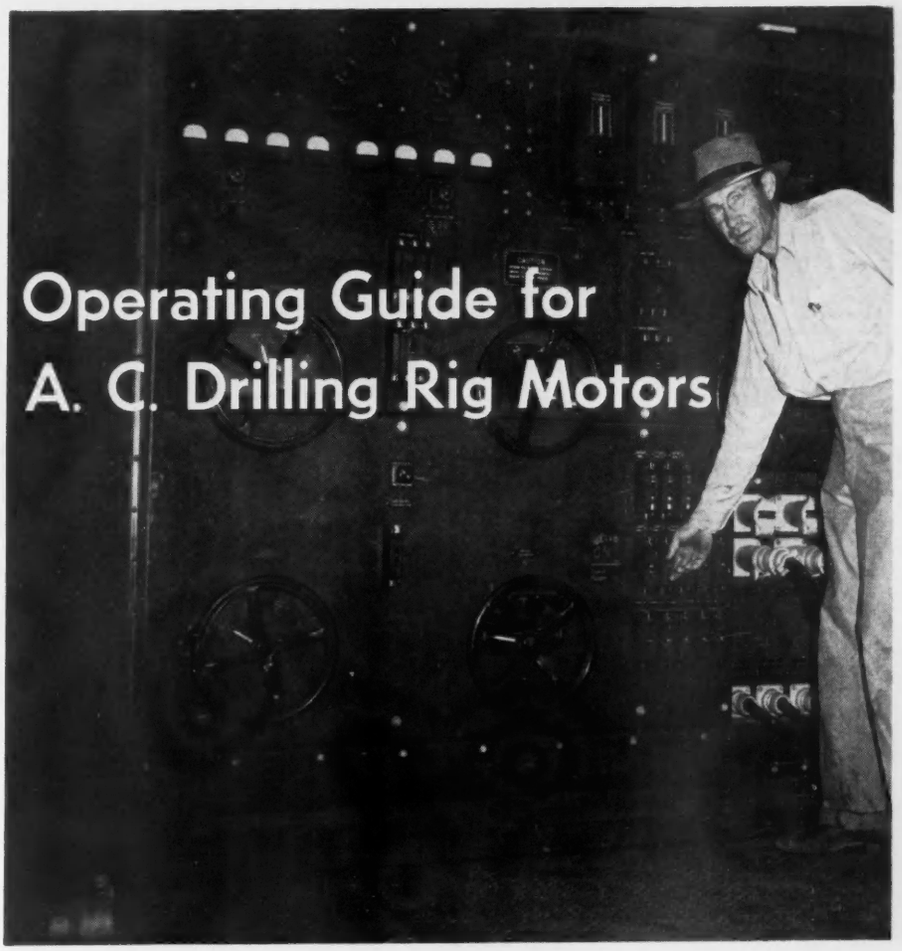


Carrying weight where hose overlaps suction pipe breaks down hose wall, admits air leaks. Put support under pipe, not hose.



End pull breaks down hose and restricts suction. A long mud-pit pipe needs support at inner as well as at outer end.

Operating Guide for A. C. Drilling Rig Motors



MANY MODERN drilling rigs are electrically driven. Such units are easy to control, compact, and economical. Drawworks, mud pump, and cathead can all be operated from a central point. To get the most from motor-driven rigs, drillers and maintenance men must be familiar with the usual troubles found in the electrical end. A good knowledge of these troubles can be gained by taking a quick look at modern electrically-driven rigs.

Control panel for a portable electric drilling rig is a compact arrangement, with all units marked to indicate their use. Weatherproof doors allow the panel to be enclosed except when actually operating a control.

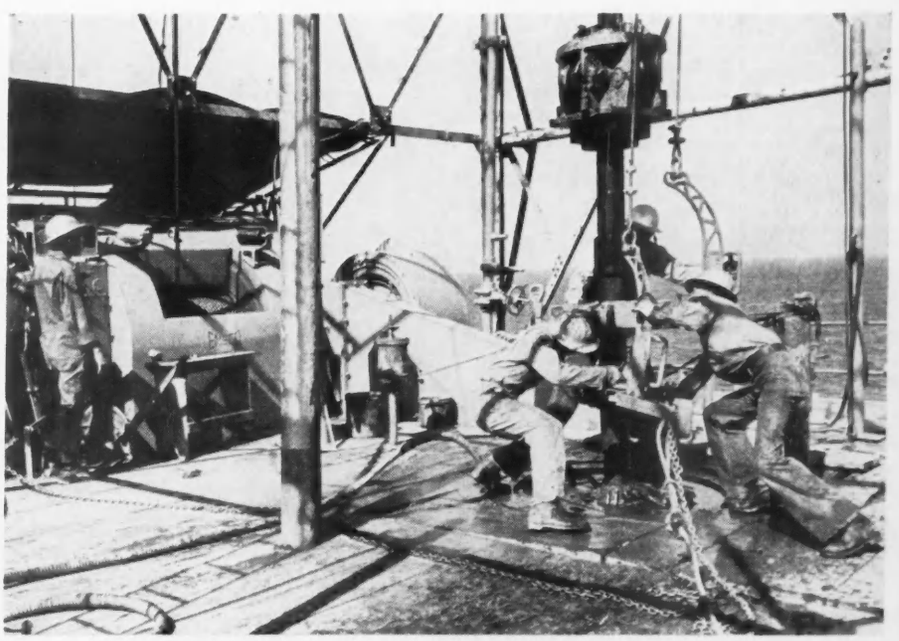
By LOUIS J. MURPHY

Consulting Electrical Engineer, New York

BOTH alternating and direct-current motors are used in drilling rigs. Type chosen depends on source of power supply, size of rig, and kind of drilling to be done. Direct-current units are extensively used for isolated rigs. Power for the motors is generated at the drilling site by an engine-driven generator. Alternating-current motors are often used for rigs located close to a municipal or other large power plant. Generation of alternating current at the drill site is possible and may be done if desired.

Since both types of current are used, many operating and maintenance problems can arise which may reduce drilling speed or cause an outage for repairs. Records show that where drillers are aware of the common signs and causes of trouble, operation is more dependable, safer, and cheaper.

Underwriters Laboratories has classified various operating conditions



Electrically driven rigs are used, as shown here, on offshore drilling units, where power may be generated in floating unit alongside the derrick platform.

for motors. Gasoline, petroleum, naphtha, alcohols, and natural gas require use of explosion-proof motors. The Underwriters Laboratories classifies operations with these substances as "hazardous conditions," Class 1, Group D. Good maintenance, therefore, is important from both the production and safety standpoint. Motors which operate steadily but are a safety hazard can cause just as large a loss as those which fail at the wrong moment.

TABLE 1

Induction Motor Maintenance Hints

Inspection Interval	Bearings	Frame	Windings	Rotor	Starter	Fuses and Switches
Daily	Oil as needed. Check temperature by feeling bearing.	Check ground wire.	Check temperature.	Check end play.	Where oil tank is exposed to moisture, check temperature. Water in oil causes excessive temperatures.	
Weekly	Replace dirty and sludgy oil.	Check air gap and adjust if unequal.	Blow out dusty windings.	Check rotor air gap.	With frequent starting and stopping, inspect all parts of starter for wear.	Clean as needed.
Monthly	Discard and replace oil on high-speed units.				Inspect all parts for wear.	Clean as needed.
Quarterly	Drain bearings, clean with kerosene, replace oil. Clean and grease ball bearings. Carefully check high-speed sleeve bearings.		Clean winds and revarnish. In corrosive atmospheres, clean and bake. Revarnish and bake.	Treat wound rotor same as windings.		
Annually	Renew worn bearings.	Clean and paint.	Clean, varnish, bake.	Overhaul.	Change oil.	Renew pitted contacts.

TABLE 2

Induction Motor Troubles

Symptom	Trouble	Cause	Remedy
I Bearing too hot to touch, or smoking.	(a) Dry bearing.	(a) Insufficient oil; oil rings not working.	(a) Refill with clean oil after washing bearing with kerosene.
	(b) Dirty bearing.	(b) Grit in oil.	(b) Refill with clean oil after washing bearing with kerosene.
	(c) Tight bearing.	(c) Insufficient oil; oil rings not not working; grit in oil.	(c) Scrape bearing and shaft or replace bearing.
	(d) Faulty rings.	(d) Rings out of slots.	(d) Replace rings, making sure no metal adheres to sides of slot. If ring sticks or runs slowly, bevel at top or bottom with fine file.
	(e) Bearing binding.	(e) Shaft out of true.	(e) Place shaft in a lathe, true and renew bearing.
	(f) Bearing out of true.	(f) Too much strain on pulley.	(f) Shim bearing with tin or replace with new bearing.
	(g) Loose bearing.	(g) Vibration.	(g) Tighten set screws holding bearing in housing.
II Bearing hot, but no hotter than other parts of motor.	Heat transferred from rotor or stator of motor.	Motor overloaded.	Reduce load or increase motor size.
III Smoke comes from windings; part of windings hot and remainder cool; wedges over coils charred.	Displaced air gap or rotor not centered in stator.	Bearing worn on one side.	If noticed before coils are damaged, realign bearing and insert new wedges; replace coils if necessary.
IV Motor run hot; explosions and fire occur in winding.	Temporary ground or short circuit.	Dampness which causes circulating current between coils and between any coil and ground.	Bake motor until all dampness disappears; dip or brush with insulating varnish. If coils are punctured, replace with new coils. If motor is needed at once, punctured coils can be cut out, if not too many, as temporary repair.
V Motor noisy and hunts.	One coil in one phase reversed.	Wrong connection made during repair or reconnection.	Connect coil to proper group and in proper polarity.
VI Motor buzzes when fully loaded.	Loose connection on rotor bars.	Overheated bars or rings.	Tighten set screws holding rotor bars to short-circuiting rings and solder or weld them, and remove grounds.

Table Continued on Page 92

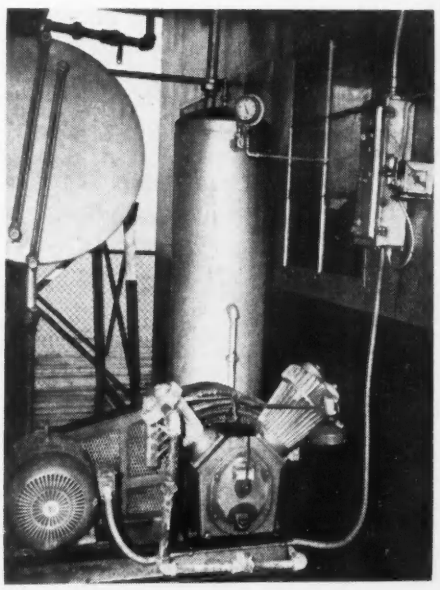
Alternating Current Motors

Squirrel-cage, wound-rotor, and synchronous motors are suitable for electrically driven rigs. In Class 1, Group O work, units for most common needs are standard and easily obtainable. Operating and maintenance problems on standard units are usually less than on others because the motor stands the tests of time before being offered for sale.

Wound-rotor and squirrel-cage induction motors resemble each other, the stator (or primary) of each being wound exactly alike. In wound-rotor motors the rotor (or secondary) is polar-wound with the ends of the windings brought out to three collector rings mounted on the shaft and insulated from it. Hence the common name "slip-ring" motor. The squirrel-cage rotor has a series of copper bars connected to copper rings at each end. Since these motors resemble each other physically, maintenance procedures are also similar.

Table 1 summarizes daily, weekly, monthly, quarterly, and yearly care and maintenance hints for induction motors. Table 2 lists common troubles, symptoms, causes, and remedies. Both tables are suitable for squirrel-cage and wound-rotor motors.

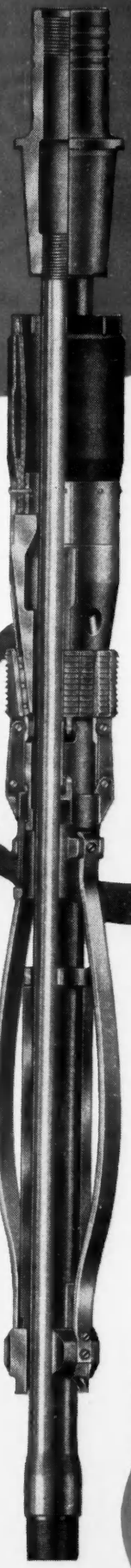
Just about the worst enemy of induction motors used in drilling rigs is dust and dirt. It chokes air ducts in laminations, fills stator to rotor air-gap, and causes lubrication troubles by contaminating the oil. Best way to



Electric motors serve as drives for auxiliary equipment, such as this air compressor unit for powering air-actuated slips, tongs and other rig equipment.

Positive Seal!

FOR DEEP HOLES...HIGH PRESSURES!

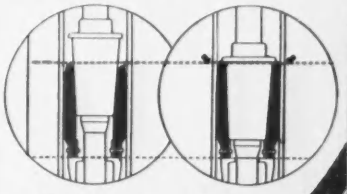


TYPE GM AMERICAN IRON

CONTROL HEAD PACKER

CHECK THESE IMPORTANT AMERICAN IRON FEATURES:

- ✓ Specially engineered dovetail slips and guides!
- ✓ Patented lateral expanding cup assembly avoids crushing of the cup in this sealing element!
- ✓ All the seal is accomplished in one sealing element!
- ✓ Patented, American Iron simple-setting arrangement!
- ✓ Full tubing size opening through length of packer!
- ✓ Smooth running because of ample fluid by-pass area!



Note how cup assembly is expanded laterally (not compressed) to avoid crushing!

GO "AMERICAN" ALL THE WAY

with this American Iron Production Equipment

AVAILABLE THRU YOUR SUPPLY STORE

AMERICAN IRON & MACHINE WORKS CO. · MANUFACTURERS OF OIL FIELD EQUIPMENT · A · REG U.S. PAT. OFF. · OKLAHOMA CITY U.S.A.

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

AMERICAN IRON & MACHINE WORKS CO.

OKLAHOMA CITY, OKLAHOMA • BOX 1177 • PHONE L. D. 518
DISTRICT OFFICE: HOUSTON, TEXAS
EXPORT OFFICE: 11 WEST 42ND ST., NEW YORK CITY, N. Y.

MANUFACTURERS OF DRILLING EQUIPMENT • PRODUCTION EQUIPMENT • FISHING TOOLS • PUMP SPECIALTIES

TABLE 2—Continued

Symptom	Trouble	Cause	Remedy
VII Motor loses power and speed when fully loaded.	Rotor out of magnetic center in respect to stator.	End play all taken up at one end of shaft due to shifting of bearings; motor out of level; or if direct connected, coupling driven too far on shaft.	Level motor; shift bearings back in place, or move coupling until rotor floats in stator.
VIII Wound rotor motor runs at half speed.	One phase open in rotor windings.	One lead to connector rings broken off or rotor windings damaged.	Test for open circuit and repair.
IX Motor runs hot; all stator coils at same temperature.	Motor overloaded.	Motor overloaded.	Test each phase with ammeter, and if reading are high, reduce load or increase size of motor.
X One or more phases hot in spots, cool in others.	Part of windings shorted.	Short circuits between adjacent stator coils.	Replace shorted coils, as they are often badly charred.
XI Motor refuses to start with starter handle in starting positions; motor hums.	(a) Motor trying to run single phase.	(a) One fuse blown or one overload relay out of order.	(a) Replace fuse or adjust relay.
	(b) Air gap displaced.	(b) Bearing out of true.	(b) Shim bearing or replace with new one.
	(c) Open circuit in stator windings.	(c) Short circuit which punctures coil, or rough handling.	(c) Insert new coil or jump damaged one.
XII Motor starts and runs, but rotor heats while stator is cool.	Abnormal currents in rotor.	Rotor bars loose or grounded.	Tighten set screws holding rotor bars to short-circuiting rings and solder or weld them, and remove grounds.

TABLE 3
Synchronous Motor Troubles

Symptom	Trouble	Cause	Remedy
I Hot bearing.	(a) Dry bearing.	(a) Insufficient oil; oil rings not working.	(a) Refill with clean oil after washing bearing with kerosene.
	(b) Dirty bearing.	(b) Grit in oil.	(b) Refill with clean oil after washing bearing with kerosene.
	(c) Tight bearing.	(c) Insufficient oil; oil rings not working; grit in oil.	(c) Scrape bearing and shaft or replace bearing.
	(d) Faulty rings.	(d) Rings out of slots.	(d) Replace rings, making sure no metal adheres to sides of slot. If ring sticks or runs slowly, bevel at top or bottom with fine file.
	(e) Bearing binding.	(e) Shaft out of true.	(e) Place shaft in lathe, true and renew bearing.
	(f) Bearing out of true.	(f) Too much strain on pulley.	(f) Shim bearing with tin or replace with new bearing.
	(g) Loose bearing.	(g) Vibration.	(g) Tighten set screws holding bearing in housing.
II Bearing, hot, but no hotter than other parts of motor.	Heat transferred from rotor or stator of motor.	(a) Motor overloaded.	(a) Reduce load or increase motor size.
		(b) Motor field over-excited.	(b) Decrease strength of field by lowering excitation.
III Windings smoking; part of windings hot and remainder cool; wedges over coils charred.	Displaced air gap or rotor not centered in stator.	Bearing worn on one side.	If noticed before coils are damaged, realign bearing and insert new wedges; replace coils if necessary.
IV Motor trips circuit breaker and shuts down, while induction motors on same system continue to run.	(a) Surge on line.	(a) (1) momentary high voltage from speeding up of alternator. (2) Lightning.	(a) No remedy. Line usually rights itself in a few seconds, and motor can be started again.
	(b) Low voltage.	(b) (1) Momentary slow-down of alternator. (2) Short circuit on line.	(b) (1) No remedy. Line usually rights itself and motor can be started again. (2) Same as (1).
	(c) Excitation ceases while motor is carrying heavy mechanical load.	(c) (1) Open circuit between exciter and motor field.	(c) (1) If exciter voltmeter shows a reading, trouble is either in motor field, in motor field rheostat, or in wiring between the exciter and motor field. Test various parts of circuit with a magneto or Megger and repair.
		(2) Exciter not operating.	(2) If exciter voltmeter does not show a reading, trouble is in exciter. Examine brushes, test field coils with low voltage or magneto, test armature for open circuit and test exciter field rheostat, and repair.

Table Continued on Page 96

avoid dust and dirt troubles is to use proper housings and keeping them tight. Once dirt gets in, however, it is most easily removed by use of a compressed-air jet. Vacuum or suction cleaners are of little use around drilling rigs because the dirt is usually oil-soaked and adheres to the windings. Air pressure used should not be more than 100 pounds per square inch.

Dirt in motor bearings will shorten their life and may cause expensive outages. Since dirt generally enters bearings when they are being oiled or greased, particular care is necessary when applying the lubricant. Also, oil should not be spilled on insulation and windings. Oil-soaked windings crack when heated, exposing the conductors.

With the data in Tables 1 and 2 any driller can spot troubles before they occur. Starting with the drillers' report, a maintenance man can find the cause and use the proper remedy. Between the two, all common causes of outages of drilling equipment should be avoided. Data in these tables will not be discussed in detail because they are sufficiently clear as presented.

Synchronous Motors

Synchronous motors require a large amount of auxiliary equipment, some of which needs fine adjustments. Extreme care is therefore necessary when operating these units on drilling rigs. In general, synchronous motors need more attention and care than induction motors. When fitted with a separate exciter, two units must be cared for, increasing maintenance time and costs.

Routine maintenance on drilling-rig synchronous motors should always include:

- Daily inspection of motor, exciter, and controls.
- Daily cleaning of motor and related equipment.
- A check of oil in the bearings to see that it is not leaking onto windings.
- Examination of exciter commutator to see that it is clean, perfectly circular, and properly undercut.
- Checking of commutator and collector ring brushes to see that they are not excessively worn and move freely.
- Monthly check of air gap in both motor and exciter to see that bearings have not worn and allowed shaft to drop.
- Bearing oil should be changed at least once every six months; more

LeRoi 600hp L-3460

EVERYTHING YOU ASKED FOR IN AN ENGINE

The L-3460, with its 600 maximum horsepower, is designed and built to meet oil-field demands for more power.

Its fast acceleration, wide speed range, lugging power at slow speeds, and compactness make it outstanding for drill-rig applications.

Its dependability and economy under continuous load, its space-saving size for easy installation, and its accessibility that simplifies maintenance give you an unbeatable power unit for any type of oil-field application — drilling, pipeline, generator drives, etc.

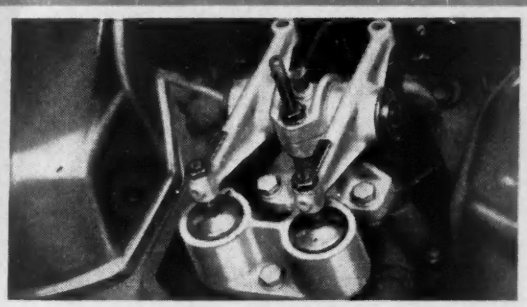
Here, in the L-3460, you have oil-field power at its best — wide speed range from 600 to 1350 rpm, and horsepowers from 350 to 600. If you want to keep a tight rein on costs, nothing but the best will do. So let the L-3460 go to work for you now — it's everything you asked for in an engine. For further information, see your Le Roi distributor — or write for our new bulletin E-3.

LE ROI COMPANY

MILWAUKEE 14, WISCONSIN

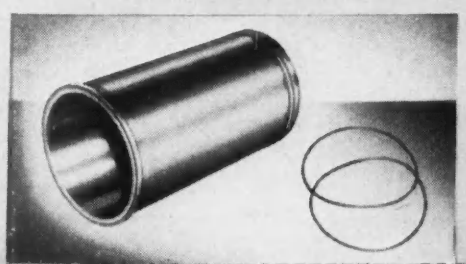
Plants: Milwaukee — Cleveland — Greenwich, Ohio • Oilfield Headquarters: Tulsa, Oklahoma

Easier Maintenance—Lower Costs



Valve-in-head design lets one man remove cylinder heads without disturbing manifold, carburetor, or controls.

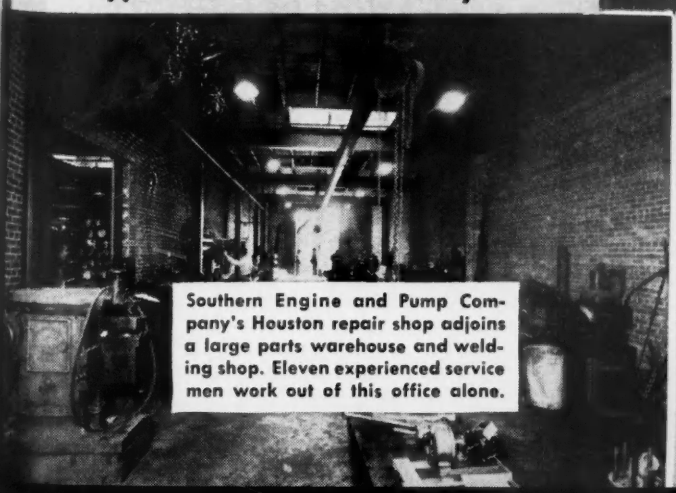
One-piece crankcase and cylinder construction provides unusual rigidity — prevents misalignment. The L-3460 is built to take the punishment of oil-field handling.



Replaceable cylinder sleeves do away with costly reboring and expensive oversize parts.

P-106

Typical LE ROI service facility



Southern Engine and Pump Company's Houston repair shop adjoins a large parts warehouse and welding shop. Eleven experienced service men work out of this office alone.

LEADS THE FIELD

Le Roi Oilfield Sales

Oklahoma
Le Roi Company Branch — Tulsa
Carson Machine & Supply Co.— Oklahoma City

East & South Texas, Gulf Coast
Southern Engine and Pump Company — Houston, Kilgore, Edinburg, Dallas, San Antonio, Corpus Christi, Texas, and Lafayette, Houma, Louisiana.

North & West Texas, New Mexico
General Machine & Supply So. — Odessa, Snyder, Texas.
Nortex Engine & Equipment Co.—Wichita Falls, Texas.

Kansas
Carson Machine and Supply Co.—Great Bend

Illinois — Western Kentucky
Western Machinery & Engine Company—Centralia, Illinois and St. Louis, Missouri.

LE ROI

IN THE FIELD . . .

Service Network

Michigan
Hafer Engine Service — Reed City

Rocky Mountain Area
Gehring Equipment Co. — Casper, Wyoming, Rangely, Col.

Northern Louisiana & Mississippi
Ingersoll Corporation — Shreveport, Louisiana, and Jackson, Mississippi.

West Coast
Le Roi-Rix Machinery Co. — Los Angeles, Long Beach and Bakersfield, Calif.

Appalachian Area
P. C. McKenzie Co., Pittsburgh

Canada
Lucey Export Ltd. — Calgary, Edmonton, Alberta.

TABLE 3—Continued

Symptom	Trouble	Cause	Remedy
V Motor growls.	Rotor out of stator magnetic center.	(a) Motor not level.	(a) Level motor bed plate.
		(b) Shaft collars shifted. Too great end play of shaft.	(b) Adjust collars for proper end play.
VI Stator windings hot.	(a) Mechanical overload.	(a) Mechanical overload.	(a) Remove part of load or increase size of motor
	(b) Low power factor.	(b) Over excitation of field coils.	(b) Adjust field excitation until stator current reaches a value where further adjustment will increase its value.
VII Burned insulation on stator coils.	Short circuit in coils.	Mechanical injury or broken-down insulation from overheating.	Jump the injured coil, or replace with new coil.
VIII Motor hums.	Motor hunts.	(a) Unstable speed of alternator supplying motor.	(a) Regulate speed of prime mover or add more bars to the squirrel cage winding.
		(b) High line resistance.	(b) Same as (a).
IX Motor buzzes.	(a) Short-circuited coil or group.	(a) Mechanical injury or broken-down insulation from overheating.	(a) Jump injured coil or replace with new coil.
	(b) Open circuit.	(b) Mechanical injury, broken-down insulation or short circuit which burns out coil and causes open circuit.	(b) Same as (a).
X Motor starts but fails to come up to speed.	Insufficient torque.	(a) Rotor field in circuit with exciter; (discharge switch in wrong position.)	(a) Open circuit between exciter and motor field windings.
		(b) Mechanical load too great.	(b) (1) Open discharge resistance.
			(2) Raise line voltage.
			(3) Increase squirrel-cage windings on rotor.
			(4) Install clutch between motor and load.
		(c) Not enough bridges or bars in squirrel-cage winding.	(c) Install clutch between motor and load.
XI (a) Motor comes up to synchronous speed but cannot be thrown on line.	Trouble in exciter circuit.	(a) Open circuit in rotor field.	(a) Test with low voltage or magneto and repair the break.
		(b) Open circuit in exciter field.	(b) Test with low voltage or magneto and repair the break.
		(c) Open circuit between exciter and motor field.	(c) Same as (b).
		(d) Open circuit in exciter armature.	(d) Bridge open circuit by connecting commutator bars each side of break.
		(e) Faulty brushes on exciter causing the same trouble.	(e) Adjust brushes if out of line, renew if broken or worn; increase tension of brushes and clean the commutator.
		(f) Open circuit in motor field rheostat.	(f) Test with magneto and repair break.
		(g) Open circuit in exciter field rheostat.	(g) Same as (f).
		(h) Field discharge switch fails to make contact.	(h) Clean contacts and renew if pitted.
		(i) Short circuit in one or more field coils.	(i) Test with low voltage and compass, repair or renew damaged coils.
		(j) Reversed coil in rotor field circuit.	(j) Test with low voltage and compass, and reverse connections of coil causing the trouble.
XII Motor won't start.	(a) Insufficient torque.	(a) Voltage too low.	(a) Increase line voltage. Starting torque of a motor having reduced voltage, starting is increased by raising compensator taps.
	(b) Open circuit in stator windings.	(b) Short circuit, rough handling.	(b) Jump or replace damaged coils.
	(c) Friction.	(c) Bearings too tight.	(c) Loosen bearing caps and if trouble persists, scrape bearing.
	(d) Overload.	(d) Mechanical load too great.	(d) Remove part of load or install clutch coupling between motor and load.
	(e) Wrong connection in compensator.	(e) One phase reversed; carelessness.	(e) Test and make proper connection.
	(f) Motor trying to start single phase.	(f) One line open; contacts on circuit breaker burned off.	(f) Test line or repair circuit breaker.
	(g) Solenoid circuit not functioning.	(g) (1) Battery circuit open or battery fully discharged.	(g) (1) Test battery circuit. Test voltage of battery; recharge if low. Clean all contacts.
		(2) Operating arms holding; circuit making and breaking contact not working properly.	(2) Lubricate operating arm bearings and see that they fall into their natural position.
		(3) Contacts dirty or burned	(3) Clean contacts once a week.

often if motor operates in a dusty atmosphere.

- Check end play of shaft.
- Change collector-ring leads twice yearly to permit equal wear. Positive ring wears faster than the negative ring.

Synchronous motor operating troubles are summarized in Table 3. From this table most of the common causes of troubles in electrically-driven drilling rigs can be found. It is helpful to both the driller and maintenance man.

Timing Maintenance

A reason frequently given for poor maintenance of drilling rigs is lack of time. With continuous, or nearly continuous operation, there isn't much time for routine checks of motor condition. However, during short shutdowns and routine stoppages of drilling it is usually possible to make rather thorough checks of one or more motors. These checks combined with a close watch of motors during usual operation will generally be sufficient to spot troubles before they become serious.

The average alternating-current motor can operate for long periods without maintenance of any sort. However, such operation affects the motor in some way or another. Bearings wear, insulation deteriorates, or controls function poorly. The usual outcome is failure in service, often at times when the motor is most needed. Excessive repair costs and loss of drilling time are the penalties paid for poor maintenance.

There is little question about good maintenance paying off, regardless of the type of motor or drilling. It always has and always will.

Order Your Copy of 1950 World Oil Index

The complete editorial index covering all issues of WORLD OIL published during 1950 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to all subscribers who write requesting copies.

Orders should be addressed immediately to the Circulation Department, Box 2608, Houston 1, Texas, as quantities are limited.

You're safer with an EMSCO bulge type portable derrick

You get structural rigidity and crown block capacity comparable to that of a standard derrick...plus PORTABILITY!

For any depth drilling you'll be *safer* with an easy-to-erect, structurally sound Emsco Bulge Type Portable Derrick. It's big and roomy. A complete setback of drill pipe can be racked in the bulge while casing is being run. The "V" window is always clear!

Lacing of all four sides eliminates the need for internal bracing, allowing more working room inside the derrick and unobstructed visibility. In addition, Emsco portable derricks are self-supporting and not dependent upon a gin pole. The load is distributed equally to all four legs, assuring an extra margin of safety.

Because of their design and construction, Emsco portable derricks can withstand actual wind velocities of 100 mph. on the naked structure and 75 mph. with a full setback of pipe.

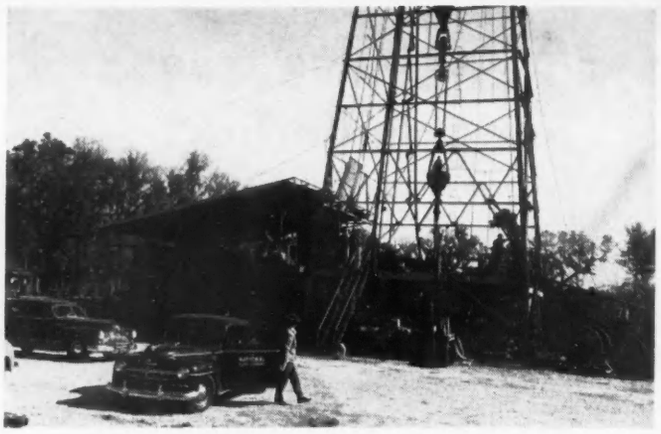
For the *safest* portable derrick you can use, see your favorite supply store or Emsco representative, or write for descriptive bulletin.

EMSCO DERRICK & EQUIPMENT COMPANY

LOS ANGELES, CALIF.

Houston, Texas Garland, Texas

Hazards In Outdated Drilling Equipment Costs



This rig, new today, must be covered by adequate reserves for its maintenance as it is used, and by a fund which not only will replace it at today's value, but at what is then the selling price of equivalent units.

By F. W. BRIGANCE

Vice President, Rowan Drilling Company, Fort Worth

PROBLEMS of increased costs have been and are continually facing the drilling industry. One of the greatest cost increases has been in capital items, although it is felt that on the whole the full effect of these increases on the industry has not been understood.

Since a 7500-foot rig is a popular size used in the Mid-Continent area, let us use the principal parts of such a rig to achieve a basis on which to compute the scope of such cost increases. (See Table 1.)

It should be noted that in 1945 the cost of the 7500-foot 3½-inch drill string was $20,944.75. While in 1951, because of the increased number of drill collars in the string, the increased cost of drill collars, drill pipe and tool joints, this drill string cost $44,360.50 or an increase of 111.80 percent. The customary charge for 3½-inch drill pipe rental which has been generally accepted throughout the oil industry has been 1¼ cents per foot. Although this drill string has increased 111.80 percent, there has been no increase allowed the drilling industry.

Table 2 shows the comparative cost and percent of increase in a 7500-foot 4½-inch drill string.

It is noticeable from the table that these principal component parts have increased on the average of 74.73 percent since 1945. Two items now used in such a rig were not manufactured in 1945, but have been included at their earliest prices as they are now included in 1951 figures. It is safe to assume that the total rig cost would also take approximately this percent of increase in cost. So far as the writer knows, the drilling industry as a whole has not adjusted its depreciation reserve charges to a comparable figure which would permit replacement of this equipment when it is worn out.

Take as an example a ten-rig contractor who does not adjust his depreciation reserves to his replacement costs. When his equipment is worn out, based on the table he will have only sufficient funds in reserve to replace 5.72 percent of his ten rigs. If this condition prevails throughout the industry, when this equipment is worn out there will be a very definite shortage of rigs or a considerable sum of new capital required to replace the rigs now in the industry.

Let us use the Permian Basin operations in the analysis of drill string cost increases. In 1945 the contractors were using an average of five drill collars in this area. Today they are running an average of 20 drill collars in their drill string. Using a 7500-foot 3½-inch drill string as a yardstick, the figures in Table 3 should be very interesting.

The drilling industry through increased efficiency and practiced economies has done a most excellent job, but there is a floor to economies and a ceiling to efficiency.

TABLE 1

Unit of Equipment	1945 Cost	1951 Cost	Percent of Increase
Consolidated type drawworks complete with coupling, brake and catheads	$23,851.00	$42,526.40	78.30
Two-engine drive group (mfd. 1947)	10,650.00	18,492.00	73.63
With guard	224.00	650.10	190.22
7¼x15 duplex power driven slush pump	9,117.00	17,858.00	95.88
5x10 duplex power driven service pump	1,872.00	3,759.00	100.80
20½-inch high speed rotary	4,987.00	8,367.00	67.78
5-sheave, 250-ton crown block	2,620.00	4,614.00	76.11
5 sheave, 250-ton traveling block	2,880.00	4,672.00	62.22
6-cylinder, 300-hp. gas engine (mfd. 1946)	7,905.00	11,077.00	40.13
Totals and average increase on above items of equipment	$64,106.00	$112,015.50	74.73

TABLE 2

		Percent of Increase
1945 Cost—5—5¼" collars at $560.00 each	$ 2,800.00	
7500' 3½" drill pipe at $241.93 cft.	18,144.75	
	$20,944.75	111.80
1951 Cost—20—5¼" collars at $913.55 each	18,271.00	
7500' 3½" drill pipe at $347.86 cft.	26,089.50	
	$44,360.50	

TABLE 3

		Percent of Increase
1945 Cost—5—6¼" collars at $680.00 each	$ 3,400.00	
7500' 4½" drill pipe at $300.20 cft.	22,515.00	
	$25,915.00	109.29
1951 Cost—20 6¼" collars at $1,062.38 each	$21,247.60	
7500' 4½" drill pipe at $439.85 cft.	32,988.75	
	$54,236.35	

Horizontal Centrifuge

DESANDS

Contaminated Mud

By ANTHONY GIBBON
Mid-Continent District Editor

TESTS OF a desander which offers the advantages of low gravity center, compactness and simplicity of control indicate that the unit will be of value on wells where the conventional settling pits prove inadequate to clean the mud. The author describes a series of Gulf Coast tests at the rig, and outlines use of the unit in drilling setup.

WHEN drilling mud becomes laden with sand particles, as frequently happens when drilling unconsolidated sand formations such as are encountered in the Gulf Coast area, the drilling engineer is confronted with the danger of extensive damage to equipment. Abrasive action of the sand-entrained mud not only results in excessive wear on drill stem, pump liners, valves and drill bits, but presents a hazard which can sometimes ruin a well and result in serious financial loss to the operator.

In recent years, drilling engineers have coped with the problem by using several methods of removing sand from the circulated drilling mud. Settling tanks and pits are most commonly used, but they are at best an ineffective method of eliminating sand particles. Various mechanical desanders have been used with more or less success. Recently a special desander which in part utilizes the centrifugal principle was tested by Stanolind Oil & Gas Company in the Gulf Coast area. Results of the test showed the unit to have a desanding efficiency of 84.7 percent.

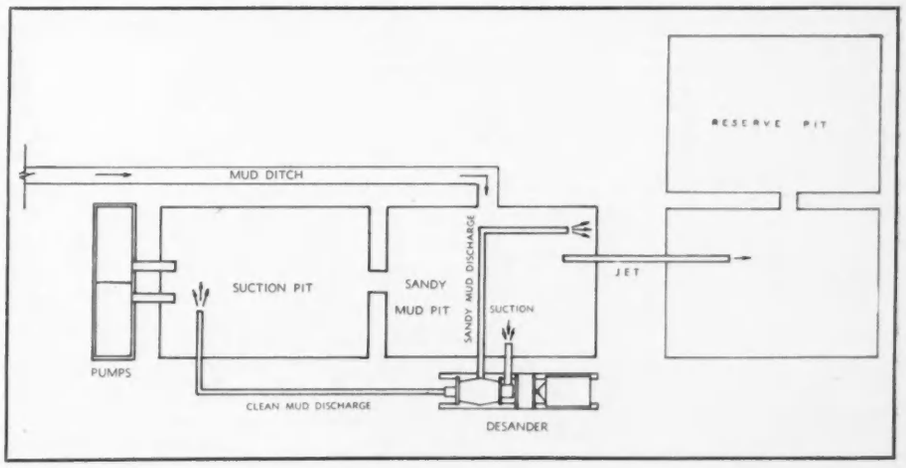
The desander is a packaged unit, powered by a recommended 130 maximum horsepower engine and operated at a centrifuge speed of 1200 to 1600 revolutions per minute. Engine and separator are mounted on a single skid. The unit produces in excess of 500 gallons of sand-free mud per minute, and can be operated anywhere within 50 feet of the mud pits or tanks. The only field connection necessary is piping to and from the pits and a gas line for fuel if natural gas is available.

The separator consists of a set of centrifugal impellers having one suction and two discharge ports. Mud to be processed is picked up by the suction from a pit at the end of the mud ditch coming from the well and the unit deposits clean mud into the slush pump suction pit through one of the discharge ports. Sand and cuttings separated from the mud are returned to the pit at the end of the mud ditch from which they were originally picked up by the separator suction. The percentage buildup of sand concentration in this pit depends on its dimensions and the amount of sand and cuttings coming from the bore. Should the sand and cuttings which were once separated from the mud re-enter the separator suction, they are again separated and returned to the pit. The separator acts as a barrier for all sand particles while producing a constant, steady flow of clean mud drawn from mud containing a large percentage of sand. Sand concentration in this pit is reduced by jetting the bottom of the pit or by other various methods of cleaning. During field tests, the mud in the bottom of this pit was found to be heavily laden with sand and very little mud was lost by steam jetting.

The desander, when operating at 500 gallons of desanded mud per minute, is capable of reducing the sand content in an average well from 15 percent to less than 1 percent in a period of four hours. This, of course, depends entirely on the amount of mud to be processed, but for average drilling operations for surface pipe on the Gulf Coast, this period of time is considered conservative. Because of this desanding efficiency, it is not necessary to operate the unit continuously during the drilling of a well, but only when it is desirable to reduce the sand content of the mud to less than 1 percent.

This desander was tested at High Island, Texas, where a pilot model was used to determine the operating efficiency of the process. Tests were made under various conditions with respect to gel, rate of mud flow through the well, viscosity, drilling

■ CONTINUED ON PAGE 102



Typical pit arrangement.

Acidizing Practices

In Canyon Reef Section, Scurry County

By G. D. SIMON

Petroleum Consultant, R. DeChicchis Consulting Firm,
Midland, Texas

USE OF ACID to open the formation in reef production has been subject to many practices, introduced through diversity of opinion as to structure, drive and other down-the-hole factors. The author reviews the methods used in 373 acidizing operations and draws conclusions from such data to offer broad recommendations for Canyon reef wells.

SINCE the discovery of the fabulous Canyon limestone reef oil section in Scurry County, Texas, there has been a production engineering problem with respect to acidizing the zone which has had to be solved for future well completions. To accomplish this, a study of past acidizing practices since the discovery of the reef is presented here to indicate which type of acid job gave the best results.

As this is essentially a statistical report of acidizing procedures of the various companies operating in Scurry County it should be borne in mind that all data presented pertain to the treatment of the Canyon limestone reef there. The section generally reacted quite favorably with acid. The conclusions drawn at the end of the paper are based upon what the majority of the operators have considered to be most feasible.

Starting with a table of the number of acid jobs versus the number of acid stages, an important conclusion is immediately apparent in Table 1.

After a period of trial the one stage acid job was found to be sufficient for most of the limestone reef wells. Of the 61 operators polled, the one stage acid treatment was generally enough for the wells to meet the top field allowable requirements.

Developing the number of acid stages preferred by the operators would logically be followed by the amounts of acid used in each job in these stages (Table 2).

It will be seen from the above data that 50 percent of all the first stages consisted of a volume less than 1000 gallons—generally 500 gallons. It is also apparent when a second stage of acid was called for, volumes of 1000-3000 gallons were usually used. Any acid stages in excess of the second treatment consisted in most cases of volumes of 1000 gallons or less. Very little work was done with volumes exceeding 10,000 gallons; however, when this much acid was used it was most commonly done in the fourth or greater stage.

Injection Pressures

In the development of any type of acid program, the engineer is constantly being confronted with the problem of injection pressures. Many factors limit the amount of pressure that can be applied to the formation. These include the size and type of pipe in the well, nearness of the zone to be treated to anticipated water zones and the cement job—particularly around the casing shoe. At the outset, there was little agreement on the type of reservoir drive present in the reef zone. It was first thought to be a water-drive reservoir and for a few months operators refrained from applying too much pressure when acidizing. Now, however, the concensus of opinion lies with a solution-gas-drive and the danger of acidizing into a water section has been discounted. When a respectable interval of reef pay is encountered, maximum injection pressures are usually found to be less than 2500 pounds per square inch.

The pressures for each job needed to break down the formation are compared with the number of stages in Table 3.

It will be noted from the above table that irrespective of the number of stages used, the most likely injection pressures are within the range of 1000-2500 pounds. This point is of unique significance in that it indicates that little difference in results can be expected by varying the pressure from the previous stage.

The problem of the best type of acid to use has created some differences of opinion in several quarters. However, since the reef material is essentially conventional lime deposits, and the Canyon reef oil is high in gravity, it does not appear than any detrimental reaction between the acid and calcareous material has taken place. The types of acid used in Scurry County indicate which concentrations give the best results (Table 4.)

All others mean a combination of

TABLE 1

	Number of Stages			
	1	2	3	4 or More
Total Number of Acid Jobs (All Companies)	275	72	14	12
Percent of Jobs per Stage	74	19	4	3

TABLE 2

	Number of Stages			
Gallons of Acid	1	2	3	4 or More
0-1000* (Percent of Stage)	171(50)	16(18)	8(30)	15(44)
1000- 3,000	118(34)	48(54)	7(26)	9(26)
3000- 5,000	27(8)	13(15)	6(22)	3(9)
5000-10,000	23(7)	11(12)	6(22)	3(9)
Over-10,000	2(1)	1(1)	0	4(12)

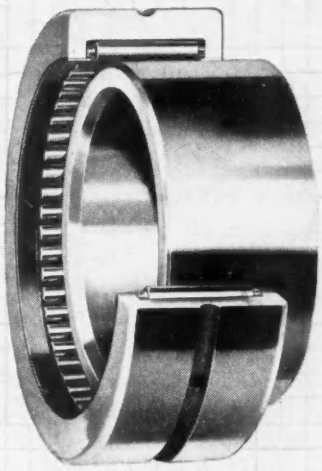
* Usually 500 gallons.

TABLE 3

	Number of Stages			
Pressure Range, Psi.	1	2	3	4 or More
0-1000 (Percent of Stage)	126(39)	13(18)	3(13)	3(13)
1000-2500	166(52)	48(66)	16(70)	15(65)
2500-3000	23(7)	11(15)	4(17)	2(9)
3000-3500	5(2)	1(1)	0	3(13)
Over 3500	1(—½)	0	0	0

giant NATIONAL pumper

...Torrington Bearing-equipped

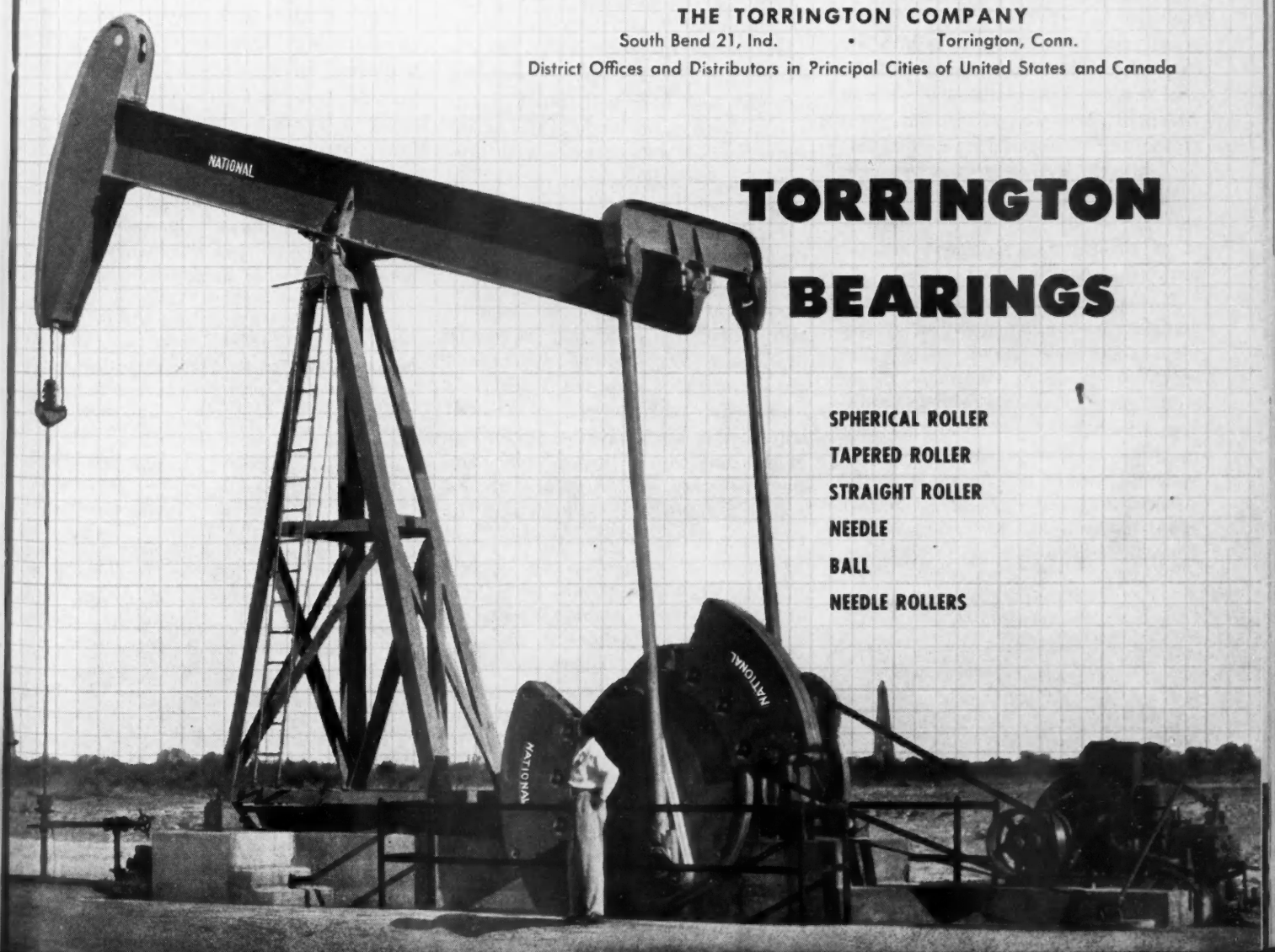


The Torrington Type NCS Needle Bearings in this mammoth National Supply Company Pumper were specified to achieve the walking beam API load rating of 32,400 pounds.

The full complement of rollers in Type NCS Needle Bearings provides high capacity and helps distribute lubricant evenly over all bearing surfaces. Type NCS Needle Bearings simplify design and assembly of saddle and pitman bearing units.

If you're looking for top efficiency in your products, investigate the advantages of these and other Torrington Bearings. Our engineers will be glad to help you.

THE TORRINGTON COMPANY
South Bend 21, Ind. • Torrington, Conn.
District Offices and Distributors in Principal Cities of United States and Canada



TORRINGTON BEARINGS

SPHERICAL ROLLER
TAPERED ROLLER
STRAIGHT ROLLER
NEEDLE
BALL
NEEDLE ROLLERS

two or more of the first four acids listed. In some of these combinations 20 percent acid was used also.

Regular 15 percent acid predominates in the selection for the initial stages as well as the third and fourth or more stages. During the second stage, a majority of the types of acid falls under the "All Others" classification. Predominating in the various combinations used in this group are the low tension and non-emulsifying acids.

Selecting the right type of acid is important and a little study of the matter can usually save the operator considerable money. As the first four types of acid listed are easily available from the major acid companies, and since these acids or their combinations can effectively react with the reef deposits, it is believed that the selection of the type of acid preferred should be no problem.

In connection with this acid work it should be remembered that for best results a wash job should precede the acid injection. The advantages realized from an initial wash job are so great that failure to use the process has seriously curtailed the productivity of some wells in areas other than Scurry County. Most operators now have established a definite wash acid program prior to injecting acid into the formation. The soaking action of the acid tends to permit the drilling mud which has been forced into the pores of the pay to migrate or disintegrate back into the well bore. As subsequent volumes of wash acid are passed over the face of the pay section, removal of the drilling mud sediments into the annulus is accomplished.

Naturally, in an open discussion of acidizing techniques, many diversified ideas are usually presented with respect to the acid treatment of oil wells. Also, experience in field acidizing is interpreted in a different light by the various operators. It is the writer's opinion, after a study of this survey, that the data as established here, based upon the results of 373 Canyon reef wells' acid treatment, represents the best approach to proper acid treatment of wells in the Scurry County area. This does not, however, mean that the presented data should preclude further study of the acidizing problem. Continued experimentation could conceivably produce even more satisfactory results.

Some operators in Scurry County follow the practice, after reaching total depth, of replacing the drilling mud with water and the water with oil. Quite often the displacing of drilling mud and water with oil has been sufficient to permit the wells to come in under natural conditions. However, when displacement was not enough to bring the wells in, a 500-gallon acid wash job was necessary to induce sufficient flow to meet the top allowable requirements of the field.

Selective acidizing has come in for some discussion in these reef wells. It is believed that proration regulations are of such a nature that the enlarging of specific channels would not help increase the permissible daily production rates over those being realized from conventional wash treatments. The more effective drainage patterns which would perhaps develop from a selective acidizing program would be somewhat extraneous with respect to the need of meeting the top allowable production rate. Consideration of the reservoir mechanics responsible for the movement of oil into the well bore will indicate that in a solution gas drive field the drainage effect is not necessarily a prerequisite for the amount of oil that is to be recovered.

Following the survey of the past acidizing practices of the operators in Scurry County, it is possible to conclude that wells should be acidized only when acid is needed to induce flowing to meet top allowable field requirements. Along with this it is found that either regular or non-emulsifying acid has the preference of the majority of the operators and the first stage of 500 gallons should consist entirely of a wash job with the exception of about two barrels of acid which should be injected into the formation. Each well should be treated as an individual problem, with the selection of 500 gallons as the first stage. If additional stages are necessary, the volumes to be employed can be ascertained following the previous stage.

TABLE 4

Type of Acid	Number of Stages			
	1	2	3	4 or More
Mud (Percent of Stage)	75(23)	5(6)	4(17)	5(17)
Regular—15 Percent	91(28)	30(35)	10(42)	13(45)
Low Tension—15 Percent	5(2)	4(5)	1(4)	1(3)
Non Emulsifying—15 Percent	72(22)	3(4)	2(8)	0
All Others	85(25)	43(50)	7(29)	10(35)

ACKNOWLEDGMENT

The writer wishes to thank Dowell Incorporated, Chemical Process Company and Western Company for their cooperation in the gathering of the statistical acidizing data used in this article.

Horizontal Centrifuge

■ CONTINUED FROM PAGE 99

speed and mud weight. Centrifuge speed and valve settings were also varied for trial purposes. During one test, the separator processed mud containing 7 percent sand and reduced the sand content to less than 0.20 percent going into the slush pump suction pit. Readings were taken hourly at five different points in the mud circulation system. The laboratory report in Table 1 shows the analysis of a sample taken at random during the tests.

The difference in weight in the two muds was considered to be necessary because of the large percentage of sand removal. The drilling program required a mud weight of from nine to ten pounds per gallon. This prevented conclusive tests to establish the effect of separation on the higher weight muds necessary for adequate protection in zones where gas or abnormal pressures are encountered. However, to investigate this point further, the separator was returned to Tulsa for additional tests. Simulated conditions were used and the results showed no loss of barytes in the clean mud discharge stream.

Tests on the well were made using a pickup suction from earthen pits. Similar tests have been conducted using a flooded suction from steel tanks above the ground level. The results appear so closely related they may be considered the same, although the volume of flow is increased approximately 30 percent when the flooded suction is used.

TABLE 1

Desanded Mud to Slush Pump Suction Pit

Weight	9.7 lbs.
Viscosity	33 sec.
Total sand and solids content in sample (+200 mesh and —200 mesh)	17.9 percent
+200 mesh sand (percent of total sand and solids)	4.0 percent
—200 mesh solids (percent of total sand and solids)	96.0 percent
+200 mesh sand content (percent of total sample including water)	.7 percent
—200 mesh solids content (percent of total sample including water)	17.1 percent

Mud Returned to Separator Suction Pit
(for recirculation through separator)

Weight	10.0 lbs
Viscosity	34 sec
Total sand and solids content in sample (+200 mesh and — 200 mesh)	28.5 percent
+200 mesh sand (percent of total sand and solids)	68.7 percent
—200 mesh solids (percent of total sand and solids)	31.3 percent
+200 mesh sand content (percent of total sample including water)	19.4 percent
—200 mesh solids content (percent of total sample including water)	8.9 percent

BUCKLING

Of Rotary Drilling Strings

Part I

By ARTHUR LUBINSKI
Stanolind Oil & Gas Company

THE THEORY of elasticity is applied to the drilling string and the critical conditions for which the buckling occurs are investigated. The location of points where the buckled pipe is tangent to the wall of the hole and the force with which it contacts the wall are determined. The location of points of maximum stresses and the value of these stresses are also calculated. The inclination of the bit is investigated. Means to prevent buckling and advice to minimize its effect are given. Those comprise essentially carrying of proper weights on bit or use of special drilling methods. This paper is substantially as presented before the 1950 Spring Meeting of the Division of Production, API, held in Oklahoma City.

THE fatigue and failures of the drilling string have been a subject of numerous investigations, as reference to the bibliography presented with this paper will indicate, but to the best knowledge of the author no mathematical approach of the problem has been undertaken. In order to allow the conclusions of this investigation to be easily read by those who are not interested in mathematical developments, the derivation of formulae is given in an appendix.

With no weight on bit, a drilling string is straight on condition that the hole is straight also. With a sufficiently small weight on bit, the string remains straight. As the weight on bit increases, a so-called critical value of weight is reached, for which the straight form of the string is no longer stable; the drilling string buckles and contacts the wall of the hole at a point which we designate as point of tangency. If the weight on bit is further increased, a new critical value is reached for which the drilling string buckles a second time. This is designated as buckling of the second order. For still higher weights on bit bucklings of the third and higher orders occur.

At the point of tangency, the drilling string rubs against the wall of the hole and is the cause of caving in certain formations. The rubbing effect becomes worse when the force between the buckled pipe and the wall of the hole increases. When the buckled string is rotated, some reversing stresses are developed in it. These stresses increase with the diameter of the hole and result in fatigue failures of the string.

As soon as a drilling string buckles in a straight hole, the bit is no longer vertical and a perfectly vertical hole cannot be drilled. This investigation tries to find an answer to the following questions:

What are the critical values of weight on bit for which buckling occurs?

What is the shape of the buckled string?

Where are the points of tangency and maximum fatigue stress located?

What is the magnitude of the force between the buckled pipe and the wall of the hole?

In what circumstances are the stresses in a buckled string excessive?

Under which conditions may the inclination of the bit be the smallest possible?

How to avoid buckling, or, eventually, how to drill to minimize the bad effects when drilling with a buckled string?

Critical Conditions

A certain point of a drilling string is usually designated as the "neutral point." In this investigation, the neutral point is defined by the following conditions: the weight in mud of the portion of drilling string below the neutral point is equal to the weight on bit. As shown in the appendix, this point is different from the point at which there is neither compression nor tension, because such a point is displaced by the hydrostatic pressure and the pump pressure.

Each value of the weight on bit corresponds to a value of the distance between the bit and the neutral point. The critical values of this distance depend on the type of pipe or drill collars and the specific gravity of the mud. It is very convenient to measure depths not in feet, but in some dimensionless units in order to get the results independent of the type of pipe, collars and mud.

It was found that the buckling of the first and second order occur when the neutral point is located 2.04 and 4.05 dimensionless units above the bit respectively. For fuller explanation, see the appendix. The length in feet of one dimensionless unit is given by the following expression:

$$m = \sqrt[3]{\frac{EI}{p}} \qquad (1)$$

where E is Young's modulus for steel in $\frac{lb}{ft^2}$

$$E = 29 \cdot 10^6 \frac{lb}{inch^2} = 4176 \cdot 10^6 \frac{lb}{ft^2}$$

I is the moment of inertia of the pipe cross section in $ft.^4$

m designates the length in feet of one dimensionless unit. The values of *m* for various types of drill pipe and drill collars are plotted on Figure 1.

p designates the *weight in mud* per unit length of the drilling string in $\frac{lb}{ft}$

The weight per foot of the drill pipe must be increased to make allowance for tool joints. The weight of a tool joint is assumed to be equally distributed over a 30-foot joint of pipe. The weight in pounds of the length

of drilling string equal to one dimensionless unit is equal to:

$$mp = \sqrt[3]{EI_p^2} \qquad (2)$$

By multiplying the values of mp by 2.04 and 4.05 respectively, the critical weights on bit of the first and second order for various types of drill pipe and drill collars were found and plotted on Figures 2 and 3. The following conclusions may be drawn from these two figures:

- A drilling string comprising only drill pipe and no drill collars buckles with a very small weight on bit. A 4½-inch drill pipe can stand no more than 1500 pounds without buckling and at 4000 pounds has already buckled twice.
- A drilling string of drill collars only and no drill pipe could stand much more weight on bit without buckling. However, the belief which is sometimes expressed that drill collars do not buckle is erroneous. In normal drilling conditions, the drill collars are generally buckled at least once and sometimes two or three times. For 6¼-inch drill collars the critical weight for the first order is between 8000 and 9000 pounds, and the critical weight for the second order is between 16,000 and 18,000 pounds. No computation has been made for buckling of higher orders, but it is expected that a third buckling would occur for a critical weight smaller than 30,000 pounds.
- The heavier the mud, the smaller are the critical weights on bit. However, the influence of the specific gravity of mud on buckling is not very significant.

Figure 4 concerns the general case of buckling of a combination string comprising 4½-inch API drill pipe (16.6 pounds per foot) and variable amounts of 6¼-inch drill collars (inside diameter 2⅞-inch). The weight on bit is plotted versus the number of 30-foot drill collars. The broken lines 1, 2 and 3 correspond to critical weights of the first, second and third order respectively. For any condition corresponding to a point located under Line 1 (such as, no drill collars and 1000 pounds on bit, or three drill collars and 6000 pounds) the string is straight. For any condition corresponding to a point located between Lines 1 and 2 (such as, three drill collars and 8000 pounds on bit, or nine drill collars and 16,000 pounds), the drilling string is buckled once. For any condition corresponding to a point located between Lines 2 and 3 (such as, three drill collars and 10,000 pounds on bit, or 12 drill collars and 22,000 pounds), the drilling string is buckled twice. The mathematical computation was made up to the buckling of the second order. Line 3 corresponding to the buckling of the third order is only approximated and, consequently, not altogether correct.

Figures 5 and 6 are similar to Figure 4. They concern drilling strings comprising 4½-inch API drill pipe (16.6 pounds per foot) with seven-inch drill collars (three-inch I.D.) and 3½-inch API drill pipe (13.3 pounds per foot) with 4¾-inch drill collars (1⅞-inch I.D.).

Lines 1, 2 and 3 of Figures 4, 5 and 6 correspond to critical conditions in a drilling fluid of specific gravity equal to one (8.35 pounds per gallon). The influence of mud density is negligible, except for heavy drill collars in a heavy mud. A correction may be made by using Figures 2 and 3. For instance, for 6¼-inch drill collars in a 17 pounds per gallon mud, Figure 3 shows that the horizontal portion of the Curve 2 of Figure 4 should be displaced downward from 18,000 to 16,000 pounds.

Let us analyze all the means which might be considered to avoid the buckling of drill strings, even if some of them do not apply to present practice.

1. The simplest means is to carry a weight on bit smaller than the critical weight of the first order, for instance, to drill with six 6¼-inch drill collars and maintain a weight on bit of only 8000 pounds. Unfortunately, such a weight is too small to drill most of the formations economically. Nevertheless, in some cases it should be carried, especially when particular

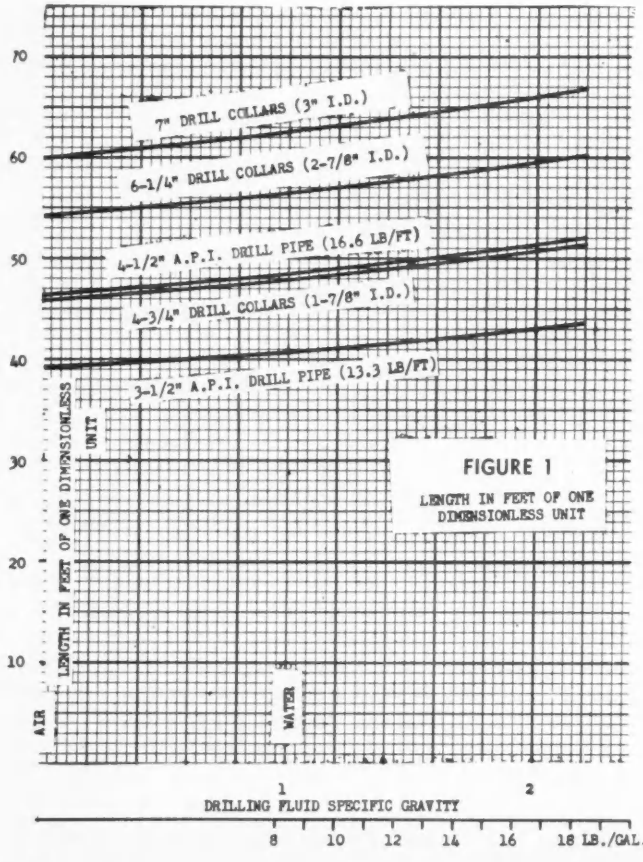

7" DRILL COLLARS (3" I.D.)
6-1/4" DRILL COLLARS (2-7/8" I.D.)
4-1/2" A.P.I. DRILL PIPE (16.6 LB/FT)
4-3/4" DRILL COLLARS (1-7/8" I.D.)
3-1/2" A.P.I. DRILL PIPE (13.3 LB/FT)
LENGTH IN FEET OF ONE DIMENSIONLESS UNIT
AIR
WATER
DRILLING FLUID SPECIFIC GRAVITY
8 10 12 14 16 18 LB./GAL.

FIGURE 1

LENGTH IN FEET OF ONE DIMENSIONLESS UNIT

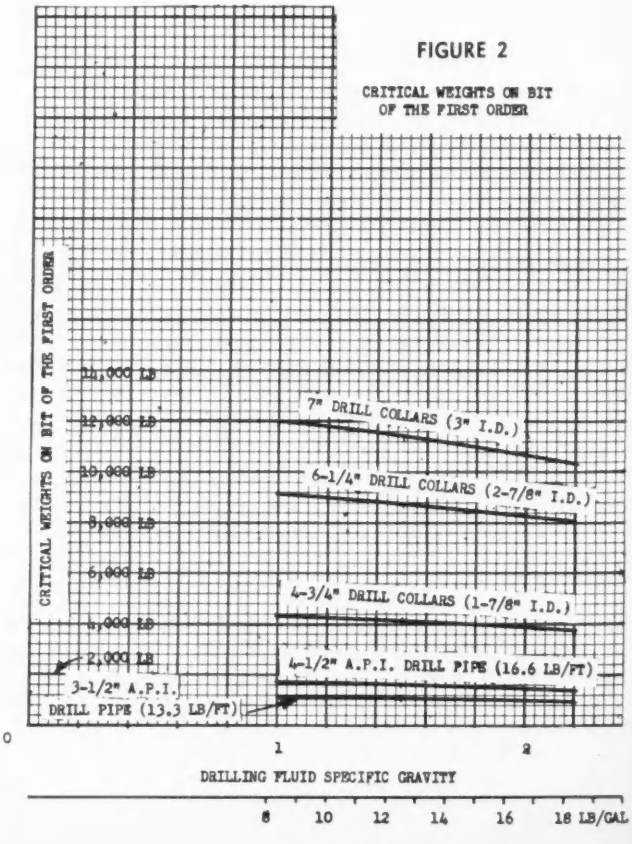
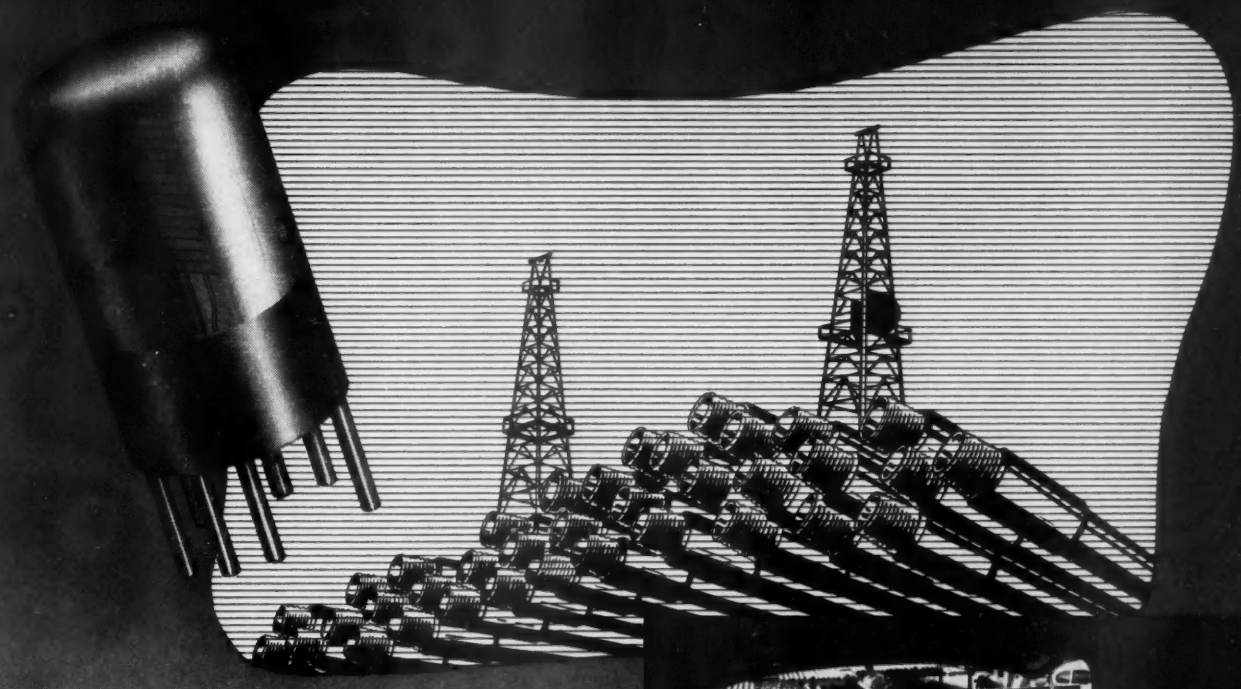
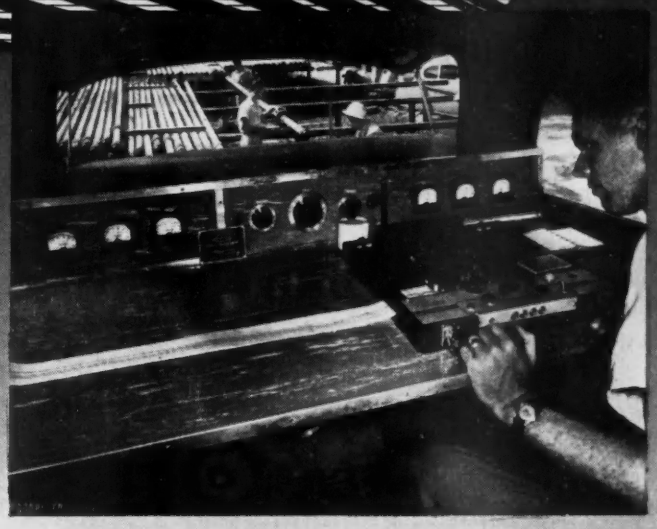

CRITICAL WEIGHTS ON BIT OF THE FIRST ORDER
7" DRILL COLLARS (3" I.D.)
6-1/4" DRILL COLLARS (2-7/8" I.D.)
4-3/4" DRILL COLLARS (1-7/8" I.D.)
4-1/2" A.P.I. DRILL PIPE (16.6 LB/FT)
3-1/2" A.P.I. DRILL PIPE (13.3 LB/FT)
DRILLING FLUID SPECIFIC GRAVITY
8 10 12 14 16 18 LB/GAL

FIGURE 2

CRITICAL WEIGHTS ON BIT OF THE FIRST ORDER





SONOSCOPE

OILFIELD TUBULAR INSPECTION

. . . the only scientifically accurate method of oilfield drill pipe inspection in the field

SONOSCOPE combines ultrasonics, magnetics, and electronics into a vastly superior and more economical inspection method in which the human element is eliminated. With SONOSCOPE not only are physical discontinuities determined and evaluated, but variations in the internal structure of the metal itself are located accurately and recorded in permanent graph form.

SONOSCOPE not only prevents costly failures from occurring in drill pipe, but it also eliminates the waste of discarding pipe which is still serviceable. With unmatched precision in the non-destructive testing of oilfield pipe, SONOSCOPE permits a scientific estimate to be made of the future useful life of each length of pipe.

Further details are available on request.

Tuboscope
OILFIELD TUBULAR INSPECTION

Division of

TUBULAR SERVICE & ENGINEERING COMPANY

COMMERCE BUILDING • HOUSTON, TEXAS

care is indicated in order to drill a straight hole or avoid enlarging a cave.

2. Analyzing the formula (2) it may be seen that the critical value of weight on bit might be increased by increasing E, I or p. It is obviously impossible to modify Young's modulus E by choosing a material other than steel. However, by using larger drill collars, both the moment of inertia I and the weight per foot p increase. The critical weights versus outside diameter of drill collars were calculated with formula (2) and plotted on Figure 7, which shows that the critical value of the weight on bit increases by large amounts for small increases of drill collar size. Nevertheless, the actual improvement is not so good, because more weight on bit is needed to drill larger holes. The curve which shows the actual improvement was also plotted on Figure 7. This curve indicates the critical values of weight on bit per square inch of bore hole versus the size of drill collars. The conclusion is that drilling larger holes with larger drill collars would avoid buckling. However, in order to obtain a significant improvement, larger drill collars than those actually manufactured would be necessary. Figure 7 shows, for instance, that to double the value of critical weight per square inch of hole, 11½-inch drill collars should be used instead of 6¼-inch. The practical difficulties to be encountered in this form of solution are obvious.

3. Some new methods of rotary drilling require less weight on bit than the conventional one. Drilling may be carried on with weights smaller than the critical values of the first order. This has been accomplished in the rotary percussion drilling method described in a recent paper.[17] The rotary percussion method was developed chiefly to be used in very hard formations, but the author suggests its use also where conventionally drilled holes go crooked. The straightness of holes drilled by this method is undoubtedly due to the fact that the drilling string does not buckle.

Critical Length in Stack

The critical length of stands of pipe or collars vertically stacked inside the derrick and supported close to the tops is equal to 2.65 dimensionless units (see Figure 1), that is to say, equal to:

104 feet for 3½-inch API drill pipe 13.3 pounds per foot.

123 feet for 4½-inch API drill pipe 16.6 pounds per foot.

122 feet for 4¾-inch drill collars (I.D. 1⅞-inch).

144 feet for 6¼-inch drill collars (I.D. 2⅞-inch).

159 feet for 7-inch drill collars (I.D. 3-inch).

This is in conformity with the experimentally known fact that the maximum lengths of drill pipe which might be stacked vertically in the derrick are the "thribbles" on stands comprising three joints. Longer stands must be supported not only close to the top, but also at some other point.

Next consider how the shape of the drilling string varies as the weight on bit increases from zero to some high value.

The drilling string remains straight when the weight on bit is smaller than the critical value. For the critical value, the shape of the buckled pipe is shown on Figures 8 and 10. The Curves 1 on both figures represent the axis of the drilling string. The point 0 is the bottom end or the bit. The vertical distances are measured in dimensionless units. Remember that the length of one dimensionless unit was given in Figure 1. This length does not vary much from one type of drilling string to another and is generally between 40 and 65 feet. Therefore, for any order of buckling, the shape is very much the same regardless of whether the bottom part is a drill pipe or a drill collar string. However, in the drill pipe case this shape corersponds to a much smaller weight on bit than in the case of

FIGURE 3

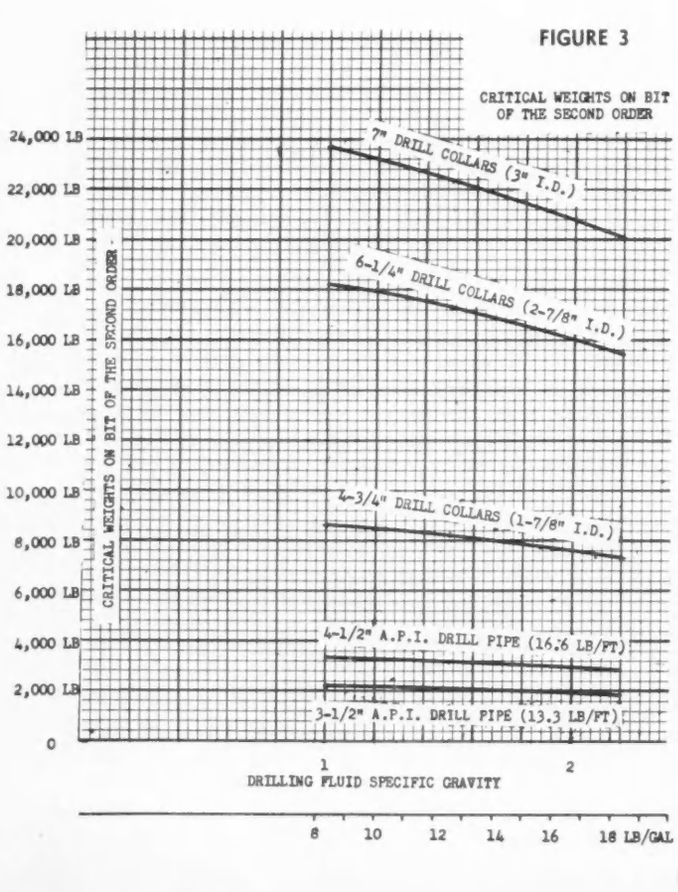
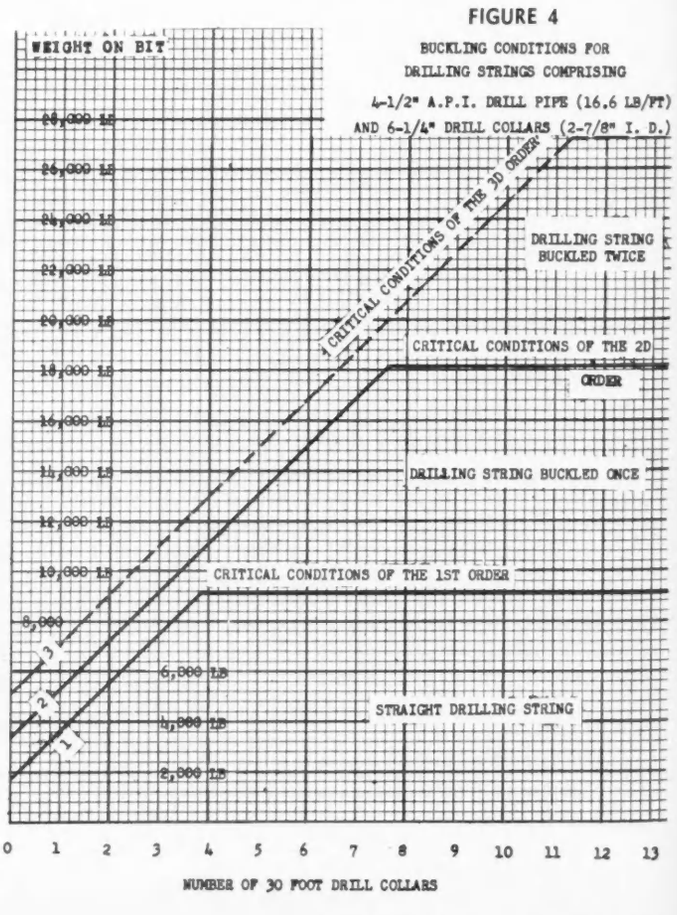
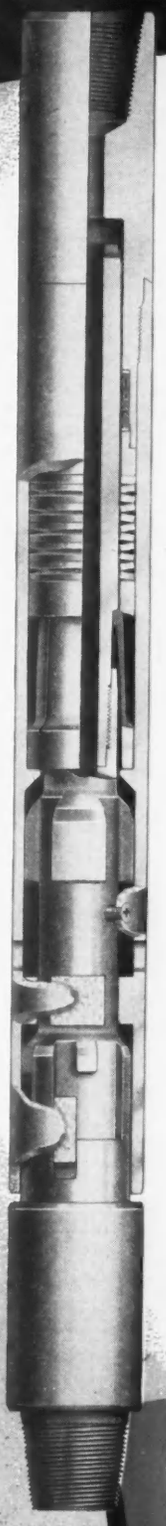


FIGURE 4



Another NEW Shaffer Advancement . . .

The SHAFFER JAR SAFETY JOINT



***Combines Jar and Safety Joint in ONE tool!**

***Sets new standards of efficiency, simplicity and compactness!**

Unequalled for Formation Testing, Casing Tests, Diamond Core Drilling, Fishing and similar operations!

WHAT it is!

The new Shaffer Jar Safety Joint combines—in ONE compact tool—*both* a straight-pull Jar and a quick-releasing Safety Joint. If the stuck string cannot be jarred loose, it can then be disconnected for recovery of everything above the mandrel of the Jar Safety Joint. Later, by simply using the recovered portion of the Jar Safety Joint at the bottom of the run-in string, the recovered string can be reconnected with the stuck portion for subsequent recovery operations. The tool embodies operating principles already field-proven in other Shaffer products—and has been successfully used by leading operators under a wide range of well conditions.

WHY it's better!

The Shaffer Jar Safety Joint not only combines two tools in one—thus saving extra costs and conserving space in the string—but it also provides greater safety and efficiency than assemblies of conventional single-purpose tools. Only a *single* pack-off is required . . . only *one* pin and *one* box . . . only a few simple parts that operate as a coordinated unit in place of many duplicated parts that cause multiple maintenance and operating problems. These and other advantages outlined at right mean safer, more efficient, and more economical operation!

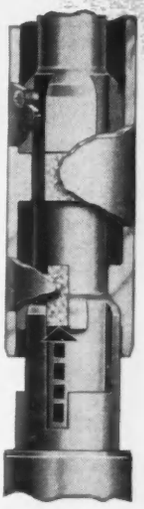
MANY APPLICATIONS

The Shaffer Jar Safety Joint is particularly recommended for use with formation testers, casing shoe tests and on fishing jobs. And, although not designed for heavy, high-speed drilling operations, it is extensively used for diamond core drilling and similar light drilling operations.

AS A JAR

The tool strikes a powerful upward blow with simply a *straight pull* on the string. *No torque or rotation of any kind is needed to strike the blow* . . . therefore, there is no interference with operation of other tools in the string. However, full torque *can* be placed in the string if desired for loosening operations—but is not necessary to operate the Jar.

- Any number of blows can be struck in rapid succession—or single blows at any desired intervals—by simply raising and lowering the string. Every time the string is lowered the tool automatically "resets." Raising the string strikes the blow—and blows may be struck *continuously* as fast as the string can be raised and lowered.
- Force of the blow is easily adjusted over a range of 10 to 60 tons in 5 ton steps, so that virtually any desired blow can be struck.
- The tripping mechanism does not depend upon friction for operation and strikes a steady, uniform blow.
- All rotational loads are carried by heavy drive keys—not by threads. Since the drive keys are stronger than the run-in string, any amount of torque can be applied to the string—in *either* direction.

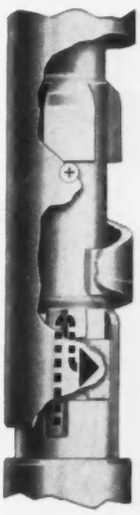


Drive keys remain in locking slot as the blow is struck

AS A SAFETY JOINT

. . . this new Shaffer tool is also superior. Since there are no tight-fitting joints or threads to "force," quick release can be effected whenever desired by simply following a few simple operations in proper sequence.

- Only 1/6th turn is needed to release the Safety Joint, eliminating risk of unscrewing other threads in the string.
- Until the Safety Joint is first made ready to release, *any* amount of torque—in *either* direction—can be applied through it without danger of release.
- At any desired time after release, the Safety Joint can be reconnected *in the hole* for further recovery operations.



Rotating drive keys into unlocking slot releases Safety Joint

Get *The Full Details* on this new Shaffer development from your nearest Shaffer representative. Or write direct!

SHAFFER

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

SHAFFER TOOL WORKS, Brea, California • California Service Shops: Santa Fe Springs and Taft
HOUSTON, TEXAS, 6006 Navigation Blvd. • ODESSA, TEXAS, 1925 West Second Street
OKLAHOMA CITY, OKLAHOMA, Acme Oil Tool Company, 1001 S. E. 29th Street
CASPER, WYOMING, Shaffer Tool Works, Post Office Box 1788
EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

27 YEARS OF OIL TOOL LEADERSHIP

drill collars (Figures 2 and 3).

Referring to Figure 8, N_1 indicates the location of the neutral point (2.04 units above the bit). T_1 indicates the point of tangency which is located somewhat lower but close to the neutral point.

As the weight on bit increases above the critical value, the shape of the buckled string changes progressively as shown on Figure 10 by Curves 2 and 3. The point of tangency

FIGURE 5

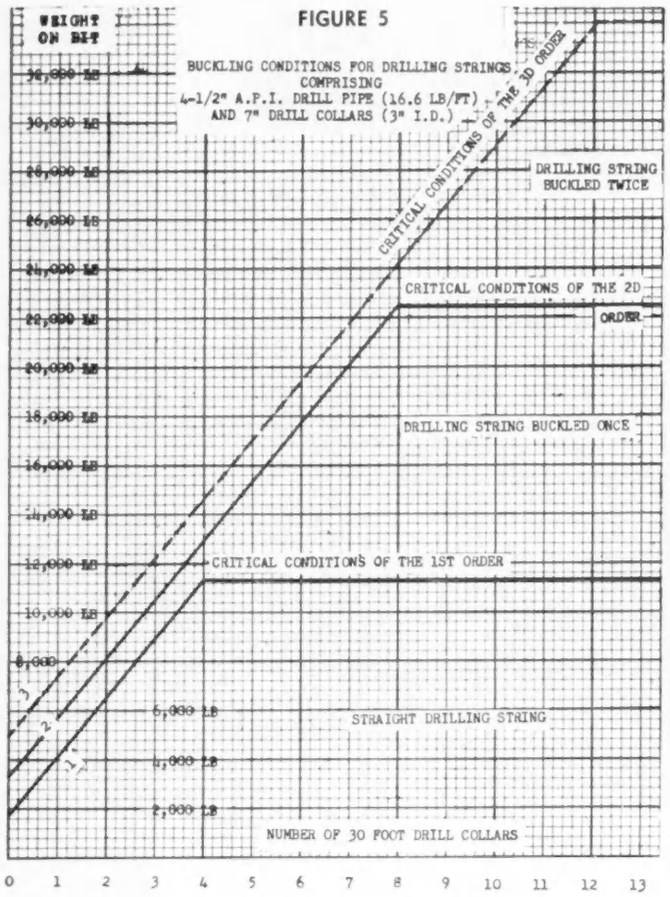

WEIGHT ON BIT
BUCKLING CONDITIONS FOR DRILLING STRINGS COMPRISING 4-1/2" A.P.I. DRILL PIPE (16.6 LB/FT) AND 7" DRILL COLLARS (3" I.D.)
CRITICAL CONDITIONS OF THE 3D ORDER
DRILLING STRING BUCKLED TWICE
CRITICAL CONDITIONS OF THE 2D ORDER
DRILLING STRING BUCKLED ONCE
CRITICAL CONDITIONS OF THE 1ST ORDER
STRAIGHT DRILLING STRING
NUMBER OF 30 FOOT DRILL COLLARS

FIGURE 6

BUCKLING CONDITIONS FOR DRILLING STRINGS COMPRISING 3-1/2" A.P.I. DRILL PIPE (13.3 LB/FT) AND 4-3/4" DRILL COLLARS (1-7/8" I.D.)

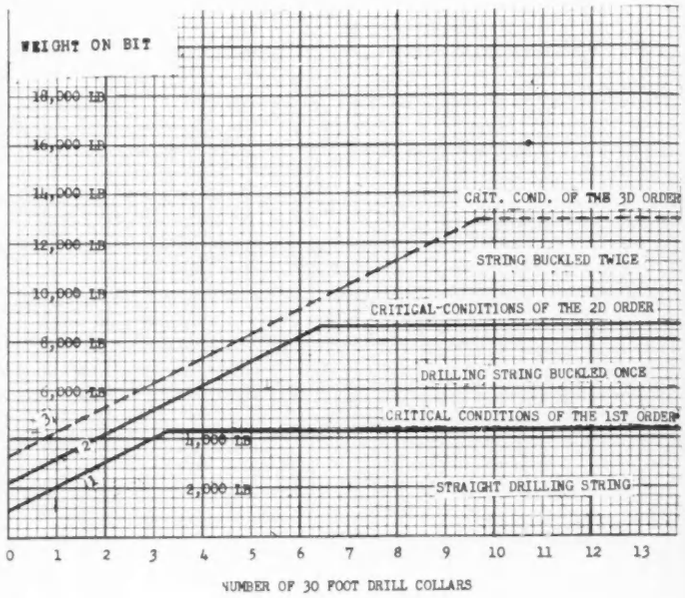
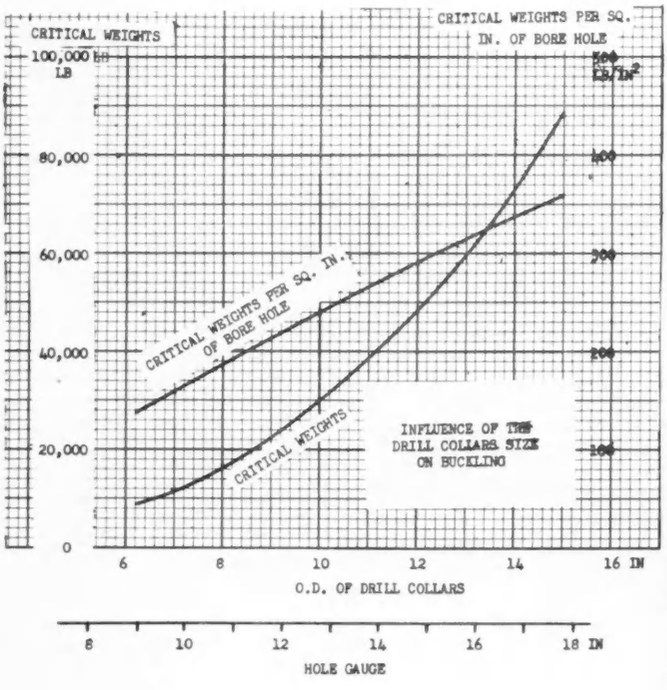

WEIGHT ON BIT
CRIT. COND. OF THE 3D ORDER
STRING BUCKLED TWICE
CRITICAL CONDITIONS OF THE 2D ORDER
DRILLING STRING BUCKLED ONCE
CRITICAL CONDITIONS OF THE 1ST ORDER
STRAIGHT DRILLING STRING
NUMBER OF 30 FOOT DRILL COLLARS

FIGURE 7


CRITICAL WEIGHTS
CRITICAL WEIGHTS PER SQ. IN. OF BORE HOLE
CRITICAL WEIGHTS PER SQ. IN. OF BORE HOLE
CRITICAL WEIGHTS
INFLUENCE OF THE DRILL COLLARS SIZE ON BUCKLING
O.D. OF DRILL COLLARS
HOLE GAUGE

FIGURES 8 AND 9

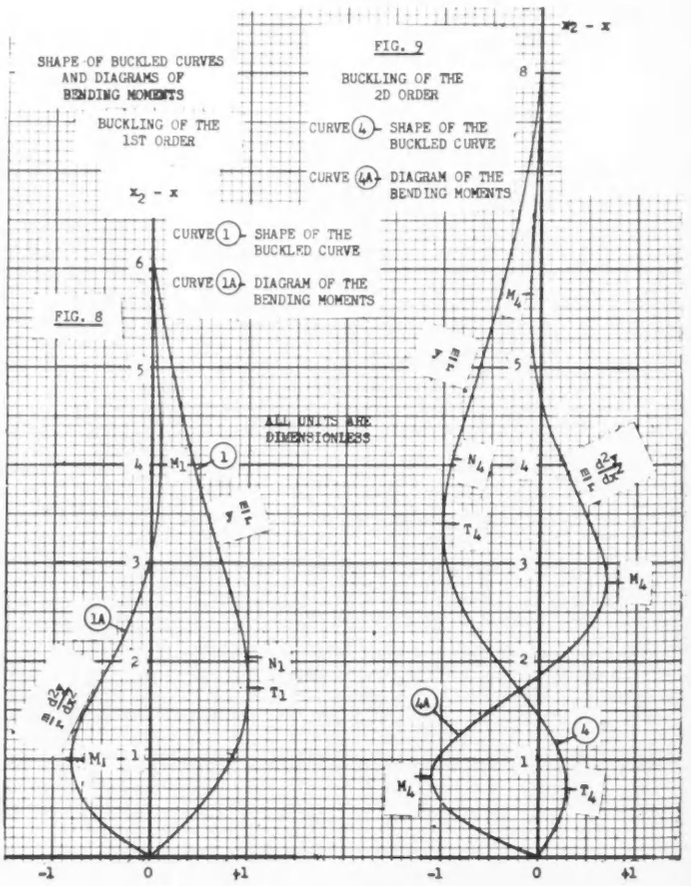
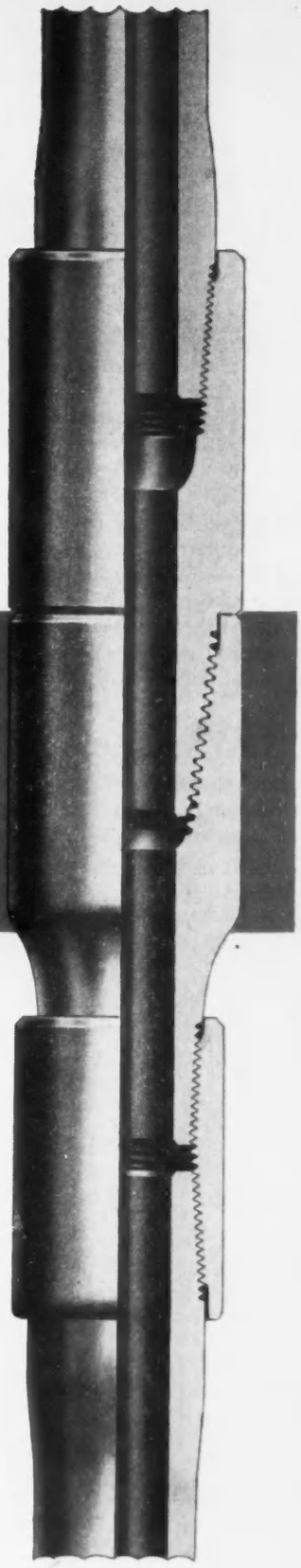


FIG. 9
SHAPE OF BUCKLED CURVES AND DIAGRAMS OF BENDING MOMENTS
BUCKLING OF THE 1ST ORDER
BUCKLING OF THE 2D ORDER
CURVE (4) SHAPE OF THE BUCKLED CURVE
CURVE (4A) DIAGRAM OF THE BENDING MOMENTS
CURVE (1) SHAPE OF THE BUCKLED CURVE
CURVE (1A) DIAGRAM OF THE BENDING MOMENTS
FIG. 8
ALL UNITS ARE DIMENSIONLESS

CONSERVE your tubing

SAVE on round-trip time

REDUCE your operating costs



REED
TUBING TOOL JOINTS

- Increase the life of the tubing by reducing wear on the tubing threads.
- Reduce leakage because tool joint connections may be broken many more times than tubing connections.
- Reduce the tendency of the couplings to split longitudinally, as the tool joints receive the tong wear during round trips.
- Decrease round trip time 25 to 40 percent, because tubing equipped with tool joints can be run with speed equalling that of drill pipe.
- Reduce transportation charges when the string is used in place of small drill pipe.

When used on a work-over string, the time required to install **REED** Tubing Tool Joints can be regained in two trips, due to the speeding up of make-up and break-out time . . . and the life of the tubing will be greatly increased.

REED ROLLER BIT COMPANY

HOUSTON 1, TEXAS

NEW YORK **LONDON** **BUENOS AIRES**

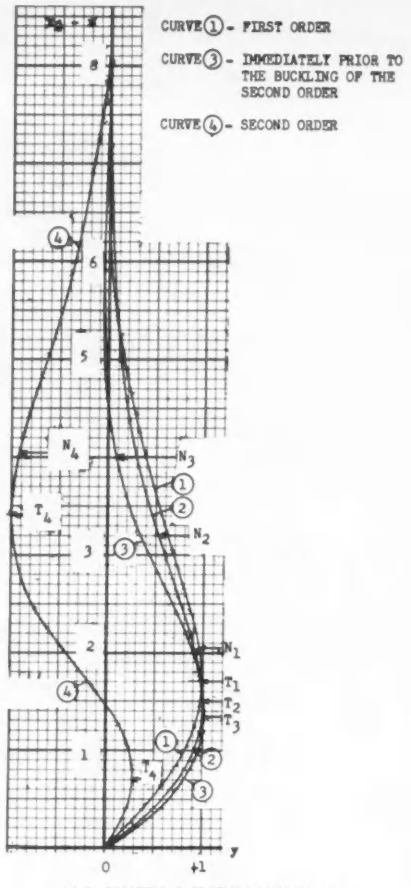
2655

(T_2 on Curve 2 and T_3 on Curve 3) is displaced downward by small amounts while the neutral point (N_2 on Curve 2 and N_3 on Curve 3) is displaced upward by much larger amounts.

When the critical value of the weight on bit corresponding to the second order of buckling is reached, the buckled form of the first order becomes unstable, and the drilling string buckles a second time (Figure 10, Curve 4, neutral point N_4 at 4.05 units from the bit, tangency point T_4). There are two points where the tangent to the drilling string is vertical (both are designated T_4). The lower one is much closer to the axis of the hole than the upper one, and consequently the upper one is the point of tangency where the drilling string contacts the wall of the hole. Immediately prior to the buckling of the second order, the point of tangency T_3 was far below the neutral point N_3. When buckling of the second order occurs, the point of tangency is displaced upward close to the neutral point. Consequently, the distance between the bit and the point of tangency does not increase continuously with weight, but decreases between critical weights and reaches a minimum immediately prior to the buckling of the second order. This minimum value is equal to 1.33 dimensionless units (point T_3) which corresponds to 78 feet in the case of 6¼-inch drill collars. This length is the safe distance above the bit for which the drilling string never contacts the wall of the hole. For all types of drill collars, the point T_3 is located somewhere in the third joint from the bottom.

The knowledge of the location of the point of tangency may be useful. To drill the first 70 feet of a caving shale any weight on bit is convenient, but thereafter it is best to maintain the weight under the critical value of the first order (about 8000 pounds for 6¼-inch drill collars); or, if this is difficult, increase the weight above the critical value of the second order (about 20,000 pounds for the same collars) because the point T_4 is located 3.4 units (about 190 feet for the same collars) above the bit.

In certain areas, for instances, in the Lindsay fields, Oklahoma, some formations have a tendency to cave and let large boulders drop into the hole, causing considerable trouble. With the thought that a special mud might solve the drilling difficulties of the area, a special API committee was founded. After prolonged investigation it came to the conclusion that



ALL UNITS DIMENSIONLESS

FIGURE 10. Shape of buckled curves.

no mud could lift the large and heavy boulders through the caves. A new approach to the problem is needed and the possibilities of special drilling methods must be considered. The use of weight on bit, suggested above, is advised. Another possibility to avoid buckling is by drilling with the rotary percussion method previously analyzed.[17] The evidence of the fact that the caves are not made by the bit, but by the drilling string rubbing against the wall of the hole is given by logs.

Figure 11 represents a comparison of Runs 1 and 2 of an electric log of the same well in the northeast Lindsay field. In the shale, the top of which is located at 9964 feet (i.e. 48 feet above the bottom of Run 1), the normal resistivity curve shows a smaller apparent resistivity in Run 2 as compared to Run 1. As the mud resistivity remained almost the same and no invasion occurred in the shale, the only reason for the change is a cave created between the two runs. The size of the cave may be estimated by using the departure curves. This cave was evidently made by drill collars rubbing against the wall of the hole. It is believed that it might have been avoided by carrying a weight on bit larger than the critical weight of the second order (20,000 pounds for the 6¼-inch drill collars) from 10,040 feet to the bottom of the shale. However, the best method, of course, would be to drill with a drilling string not buckled at all, by one of the methods previously described.

Force on Wall of Hole

When the weight on bit is progressively increased and the critical weight of the first order is reached, the drilling string buckles, but it contacts the wall of the hole with a force equal to zero. This fact may be visualized by means of the following consideration. When the buckling is on the verge of occurring, the slightest increase of rigidity of the pipe would prevent it. Similarly, if it occurs, the slightest force can stop it.

As the weight on bit becomes larger than the critical weight, the force applied by the buckled pipe on the wall of the hole increases as a linear function of weight. It reaches the largest value immediately prior to the buckling of the second order. As the weight on bit reaches the critical value of the second order, the force with which the buckled pipe contacts the wall of the hole drops again to zero and starts once more increasing if the weight becomes still larger. As a conclusion, let us say that this force is always larger before the buckling of any order (except the first when the pipe is straight) and smaller after. Unless it is desired to keep the tangency point low, it is always better to drill with a weight on bit slightly greater, rather than less than the critical weight of any order (20,000 pounds rather than 16,000 pounds for the 6¼-inch drill collars).

The larger the hole, the larger is the force between the buckled drilling string and the wall of the hole at the point of contact. Immediately prior to the buckling of the second order, this force F (in pounds) is equal to:

$$F = 2.3\ pr \qquad (3)$$

where p is the weight in mud of the drilling string per unit of length in pounds per foot as previously considered, and r is the apparent radius of the hole in feet. The apparent radius of the hole is the maximum distance between the axis of the hole and the axis of the drilling string. In the case of drill collars

$$r = \tfrac{1}{2}\ (D - D_c) \qquad (4)$$

and in the case of drill pipe

$$r = \tfrac{1}{2}\ (D - D_t) \qquad (5)$$

in which

r designates the apparent radius of the hole

D designates the diameter of the hole

Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA CITY • NEW YORK

OUR 31st YEAR

You can *See* it in the Design!
Feel it in the Handling
Check it on the Scales!

BAASH-ROSS "DU" ROTARY SLIPS ARE UNUSUALLY LIGHT WEIGHT

. . . and Light Weight is only ONE of *many* "DU" advantages!

Stop and think how many dozens of times the rotary slips are lifted by the drilling crew during a *single* round trip. Multiply this by repeated day-after-day, month-after-month operations and you can readily appreciate why light weight is such an important factor to look for in rotary slips. *And you really get light weight in Baash-Ross "DU" Rotary Slips!*

For example, check these figures on typical sizes of "DU" Slips . . .

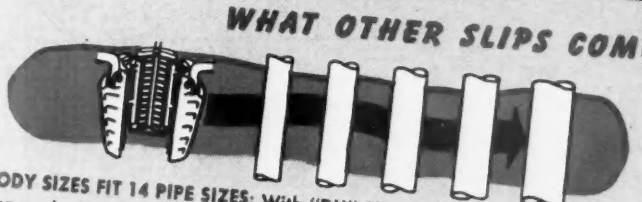
Size of "DU" Rotary Slips	"DU" Regular (12" long)	"DU" Long (16" long)
4½" O.D. Slips with 4½" Liners	137 lbs.	158 lbs.
5⅝" O.D. Slips with 5⅝" Liners	146 lbs.	177 lbs.
7" O.D. Slips with 7" Liners	154 lbs.	196 lbs.

On these and other sizes you'll find Baash-Ross "DU" Rotary Slips are pounds lighter because all excess metal has been removed without in any way sacrificing strength or ruggedness. *Notice the deeply-cored backs that replace dead metal with a cellular rib construction that combines more-than-ample strength with minimum weight.*

▶ **But most important** is the fact that unusually light weight is only *one* of many important advancements you get in Baash-Ross "DU" Rotary Slips. Carefully check through the features outlined below . . . compare them right down the line with *any other* make of slips . . . and you'll see why "DU" Rotary Slips are today's outstanding buy for maximum convenience, safety and all-around economy!

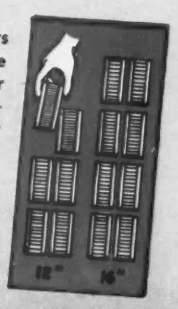
Baash-Ross "DU" Rotary Slips are available in both "Regular" length (12" long—for wells through 8000 ft. in depth) . . . and "Long" length (16" long—for the deepest wells and heaviest drill strings). For full details, see your nearest Baash-Ross representative—or write direct!

WHAT OTHER SLIPS COMBINE SO MANY OUTSTANDING ADVANTAGES?



▶ **3 BODY SIZES FIT 14 PIPE SIZES:** With "DU" Slips you don't need a separate slip for each size of drill pipe. By simply changing the liners—a quick inexpensive operation—*three* basic "DU" body sizes fit *all* sizes of tubing, drill pipe and casing from 2⅜" O.D. through 7" O.D. Cuts slip investment and maintenance to a minimum!

▶ **MONEY-SAVING SEGMENTED LINERS:** "DU" Slip Liners are in 4" segments instead of single long units. If you use both 12" and 16" Slips there's no need to stock liners for both sizes. Simply keep a supply of 4" segments on hand—use *three* 4" segments for 12" Slips . . . *four* 4" segments for 16" Slips . . . thus greatly reducing inventory costs. Also, if for any reason slip wear is concentrated at one point, liner segments can be switched or inverted to distribute wear without replacing any parts. Or if too worn, replace *only* the worn segments and use the others for additional service. Cuts maintenance costs to the bone!



▶ **SELF-ALIGNING HINGE:** "DU" Body Segments are not merely hinged together, but are unitized by a unique "floating" hinge that prevents *vertical* misalignment, yet permits them to adjust *laterally* to any irregularities in bore of master bushing. This assures a full, uniform grip under all conditions!

▶ **SAFETY LINER RETENTION:** "DU" Slips are so designed that *all* stresses—both of supporting the pipe and of breaking out joints—are transmitted directly from the liners to the slip body. There are no retaining bolts or pins to become sheared and allow liners to fall into hole. Yet liner segments can be quickly removed by simply pulling a cotter and sliding out one keystone retaining key. This double keystone key firmly mates liners and body into single rigid unit!

▶ **AND OTHER ADVANTAGES:** There are still other vital "DU" advantages . . . the safety loops on the handles that safeguard crew's hands against injury . . . the polished backs that eliminate sticking in the bore . . . the perfected grip design that will not damage the pipe . . . the flattened toes that enable "DU" Slips to stand solidly on table or floor . . . and many other unique features.

BEFORE YOU BUY ANY ROTARY SLIPS GET THE COMPLETE STORY ON "DU" ALL-AROUND SUPERIORITY!

D_c designates the O.D. of drill collars

D_t designates the O.D. of tool joints

The values of the force F were plotted on Figure 12 for various types of drill pipe and drill collars. The figure shows that the force F is not very large, a few hundreds of pounds at the most. That is why in most formations the hole remains on gauge in spite of the buckled drilling strings. However, if the formation has a tendency to cave, the rate with which the ave grows becomces faster and faster because the force involved increases with the diameter of the cave.

Bending Moments and Stresses

When the drilling string buckles, each cross-section becomes subjected to a bending moment generating a tension stress on one side and a compression one on the other. As the drilling string rotates, these stresses reverse and, consequently, they cause a fatigue of the steel. Sometimes they may be a reason for failures.

The bending moments are evidently proportional to the radius of curvature of the buckled curve. Figures 8 and 9 concern the buckling of the first and second order, respectively. Curves 1 and 4 indicate the shape of the buckled curves and the Curves 1A and 4A the diagrams of bending moments. As explained previously, the depths are measured from the bit (point 0) upward in dimensionless units. The values of bending moments are also expressed in dimensionless units. The value in ft. x lb. of one dimensionless unit of bending moments is equal to pmr (designations and units as stated previously).

The Curve 1A shows that there are two points (designated as M_1) on the drilling string subjected to the buckling of the first order, at which the bending moment is maximum. At the point M_1, which is closer to the bit, the bending moment is larger than at the upper one.

The Curve 4A shows that there are three points (designated as M_4) on the drilling string subjected to the buckling of the second order, where the bending moment is maximum. As for the buckling of the first order, the bending moment is the largest at the point M_4 which is the nearest to the bit.

The Curve 1A of Figure 8 shows that in the case of buckling of the first order the point of largest maximum bending moment is located one dimensionless unit above the bit. The lengths in feet of dimensionless units are given on Figure 2 (for instance, about 57 feet for 6¼-inch drill collars). The Curve 1A of Figure 8 shows also that the value of this largest maximum bending moment is equal to:

$$M_1 = 0.8\ pmr \qquad (6)$$

BIBLIOGRAPHY

[1] Theory of Elastic Stability, by S. Timoshenko, McGraw-Hill Book Co., Inc., New York, N. Y., 1936.

[2] Mathematical Methods in Engineering, by T. V. Karman and M. A. Biot, McGraw-Hill Book Co., Inc., New York, N. Y., 1940.

[3] Introduction to Bessel Functions, by F. Bowman, Longman, Green & Co., London, New York and Toronto.

[4] A treatise on Bessel Functions and their Applications to Physics, by Andrew Gray and G. B. Mathews, McMillan & Co., Ltd., London, 1922.

[5] Tables of Bessel Functions of Fractional Orders, Prepared by the Computation Laboratory of the National Applied Mathematics Laboratories—National Bureau of Standards; Published by Columbia University Press, Volume I 1948, Volume II 1949.

[6] Methods of Determining How Much of a Frozen or Cemented Column of Pipe is Free, by John T. Hayward, Drilling and Production Practices, 1935, Published by API.

[7] Causes and Prevention of Drill Pipe and Tool Joint Troubles, by R. S. Grant and H. G. Texter. Drilling and Production Practice, 1941, Published by API.

[8] Prolonging Drill Pipe Life, Drilling, Feb., 1945, Volume VI, No. 4.

[9] Corrosion Fatigue of Drill Pipe, by H. G. Texter, Drilling, October, 1944, Volume V, No. 12.

[10] Buckling Under Locally Hydrostatic Pressure, by G. H. Handleman, Journal of Applied Mechanics, Sept., 1946, Volume 13, No. 3.

[11] Drill Pipe Failures, by Wm. H. Crenshaw, Drilling, March, 1947, Vol. 8, No. 5.

[12] Drill Pipe Inspection, by W. H. Crenshaw, V. B. Bottoms, C. N. Wallace and C. R. O'Dell, Drilling, June, 1948, Vol. 9, No. 8.

[13] Field Tests on Rejected Drill Pipe, by A. W. Thompson and H. G. Texter, Paper presented on API Meeting, Chicago, November, 1948; Drilling, Dec., 1948, Vol. 10, No. 1, and Petroleum Engineer, March, 1949, Vol. 21, No. 3.

[14] Causes and Prevention of Drill Pipe and Tool Joint Troubles, by H. G. Texter and R. S. Grant, Revised by H. G. Texter and S. C. Moore, World Oil, Oct., Nov. and Dec., 1948, Jan. and Feb., 1949—Vol. 128, No. 6 to 10.

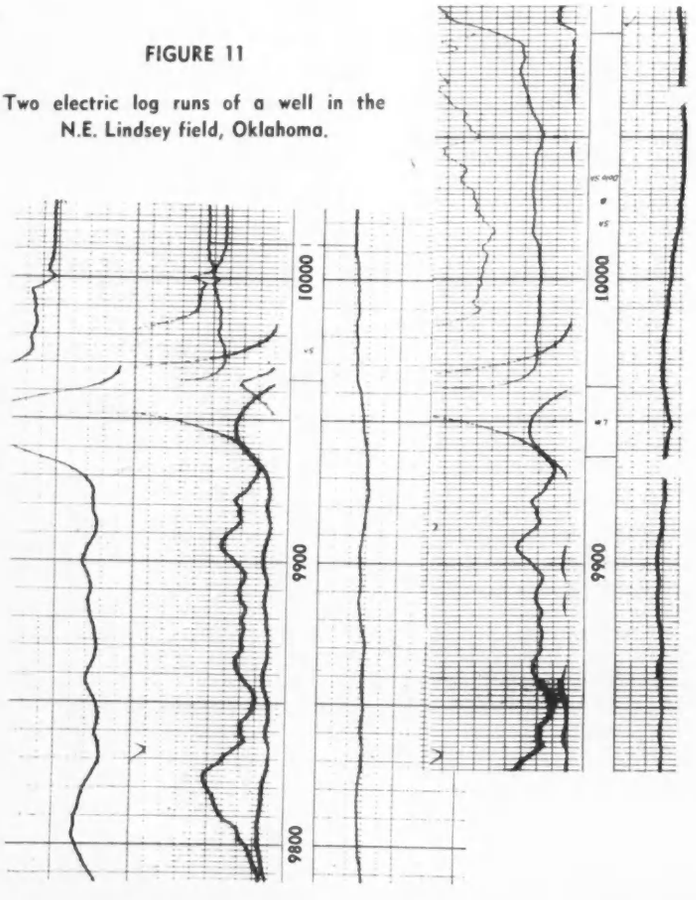
[15] The Analysis of Stresses in Drill Pipe, by M. F. Hawkins and Norman Lamont, Drilling, April, 1949, Vol. 10, No. 6. Paper presented at the API Meeting at Galveston, Texas, March, 1949.

[16] The Fundamental Mechanics of Directional Drilling, by F. A. Graser, Drilling, June, 1949, Vol. 10, No. 8.

[17] Rotary Percussion Drilling, by P. L. Guarin and H. E. Arnold. Paper presented at API Meeting, Chicago, November, 1949.

FIGURE 11

Two electric log runs of a well in the N.E. Lindsey field, Oklahoma.



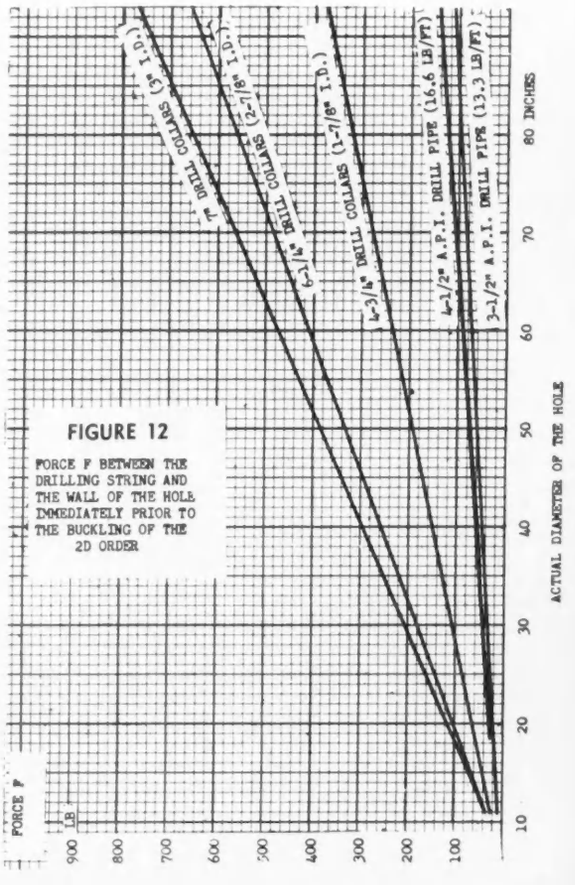
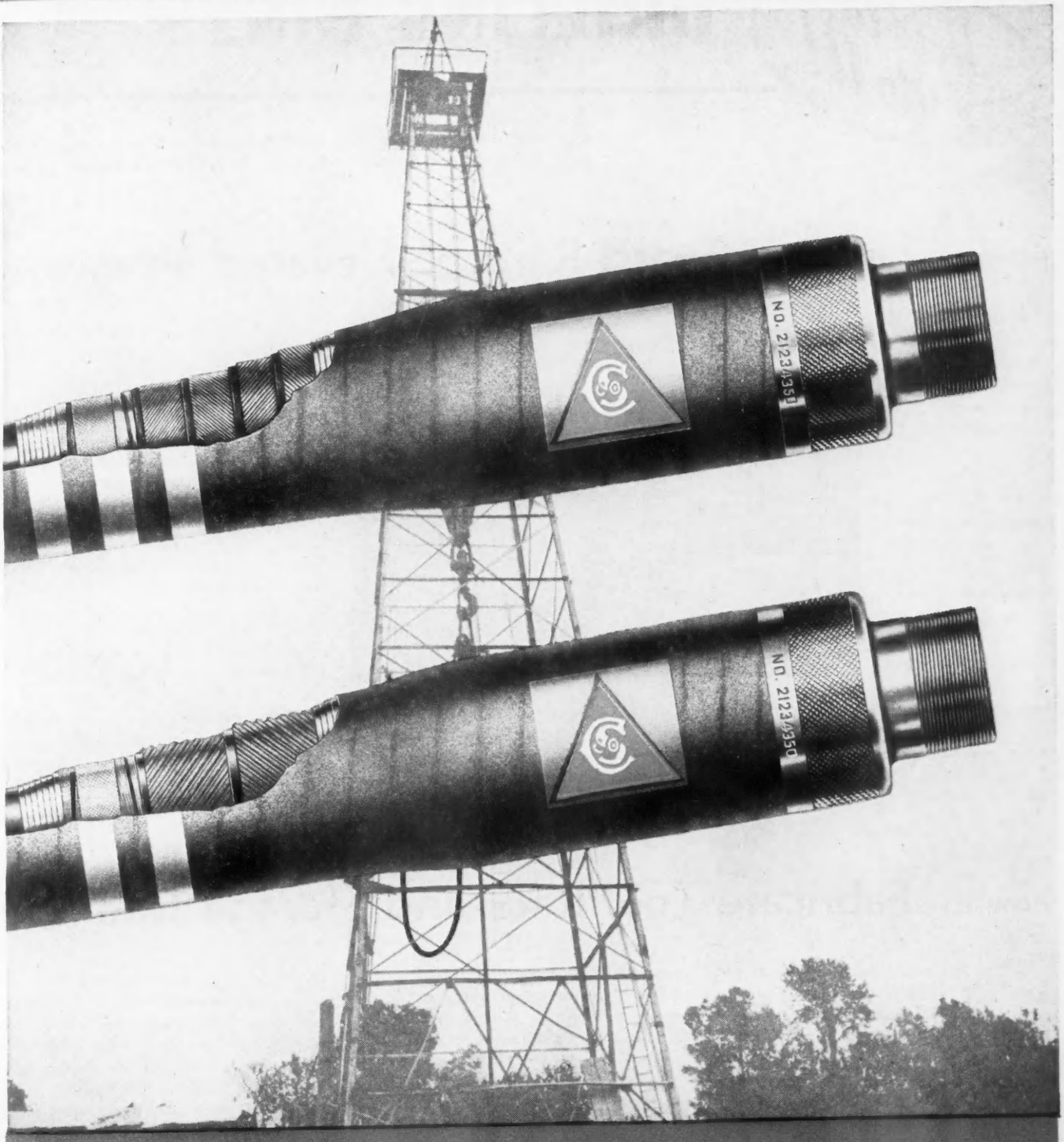


FIGURE 12

FORCE F BETWEEN THE DRILLING STRING AND THE WALL OF THE HOLE IMMEDIATELY PRIOR TO THE BUCKLING OF THE 2D ORDER

for the peak pressures!



SERVING THE OIL AND GAS INDUSTRIES WITH PRODUCTS OF

NEW YORK BELTING & PACKING COMPANY

PASSAIC, NEW JERSEY

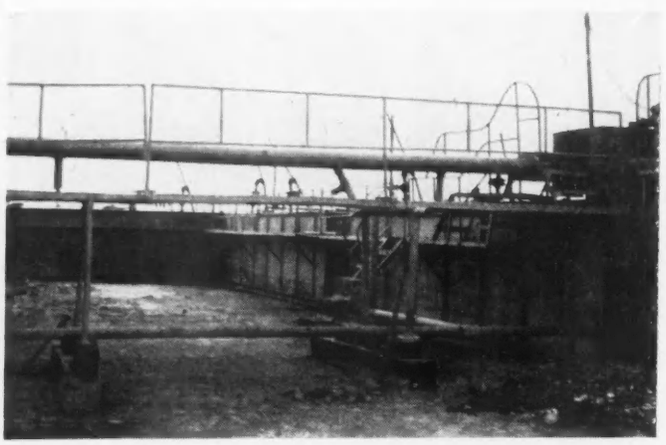
How to do it!

DRILLING HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

HOW TO—Unitize Guard Rails of Elevated Walkway

By unitizing the guard rails secured to elevated walkways around the mud tanks and adjacent to the mud return line, considerable saving in time can be effected when rigging up. Large rectangular mud tanks are becoming more popular as a means of handling the drilling fluid. Not only do they facilitate cleaning up the location after the well has been drilled, but they aid in conserving water used to prepare the mud in areas where water is a problem.



Because, in most cases, the mud guns are clamped or mounted to the upper edge of these tanks, experience has shown that the best method of using the tanks is to erect an elevated walkway around the pumps so that the drilling crew can manipulate the guns and at the same time see what is happening in the tank. For safety reasons, a small hand rail is added to the outside of the walkways adjacent to the mud tanks for the safety of crewmen working on the elevated platforms, particularly at night when visibility is limited. A handrail is also added to the elevated walkway extending from the rig (at blowout preventer level) to the shale shakers.

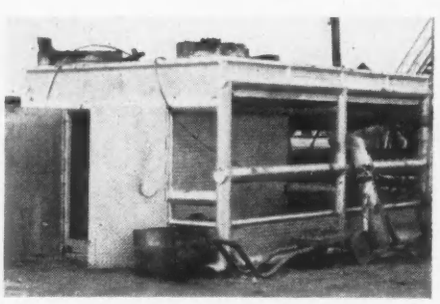
There are almost a hundred linear feet of railing on the rig illustrated, and to facilitate its installation at new location, the railing is unitized into sections. Each section is about 12 feet long and welded so that only one leg is provided. A "half-leg" at the opposite end fits into a well attached to the leg of the adjacent section. The well is made of the next size pipe for a tight fit. Each leg is inserted into a short nipple welded to the angle iron frame of the walkway. Where the workmen have to step over the return mud line, the railing is elevated to a convenient height to encourage its use.

HOW TO—Fabricate Tool Rack and Storage Room

Storing frequently used tools, parts and consumable supplies is always a problem around the drilling rig. When a part or tool is needed little time can be wasted in locating it. A sturdy tool rack made of salvaged pipe and floor plate serves this need.

Over-all dimensions are about 18 x 6 feet, and the height of the rack is about one foot above the abutting pipe racks. This combination tool rack and storage room accommodates outside and inside storage. Steel plate flooring is welded to completely cover the rack. This flooring is adequately braced so that the floor is actually about 12 inches below the top rail surrounding the entire unit. The railing is made of smaller pipe and webs of floor plate welded in place to form a fence around the upper part of the rack. The enclosed area is designed for storage of loose parts and pipe fittings, such as subs, tees, ells, and nipples. It can easily be used for pipe protectors as well.

The area of the rack enclosed by the skid runners and cross braces at each end is completely floored with steel plate, and another enclosure is formed by adding a railing at the bottom and adding floor plate. Undercover storage is provided here. Mud pump parts, rubber gaskets, rags, etc., can be stored in this section.



A totally-enclosed compartment is made by adding sides to part of the rack so that a tool house results. Floor plate is used again, and also forms the two doors which are hinged at each side by a long rod connection. This door can be locked so that other valuable items can safely be stored. Inside, racks and bins handle electrical supplies, light bulbs, and other consumable items. A convenient feature of this rack is that it can be loaded with parts and supplies for transport to another location when moving the rig.

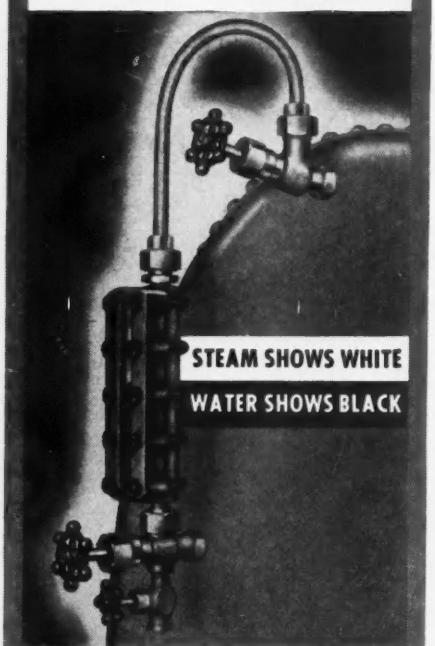
PROOF
of the Pudding
. . . is in the service!
Yes, our most important job is to see that you get the oil field supplies you need—when you need them. We take a great deal of pride in helping you get your job done with the least possible expense. The quality of our nationally known products plus our conveniently located stores make it possible for us to give you the very best service in the field. Try us and you'll agree.
UNITED SUPPLY
Courtesy
Service
Dependability
UNITED SUPPLY
AND Manufacturing COMPANY
TULSA, OKLAHOMA
Stores in Kansas, Oklahoma, Texas, Louisiana, and New Mexico

PENBERTHY
Drilling Hints

Drilling contractors have long found that it pays to standardize on Penberthy products because of their exceptionally rugged construction and their dependable performance under the most severe operating conditions.

PENBERTHY INJECTOR

Penberthy Automatic Injectors are the accepted method of assuring an uninterrupted supply of feed water to boilers at minimum cost. They are quickly and easily installed—require little attention.



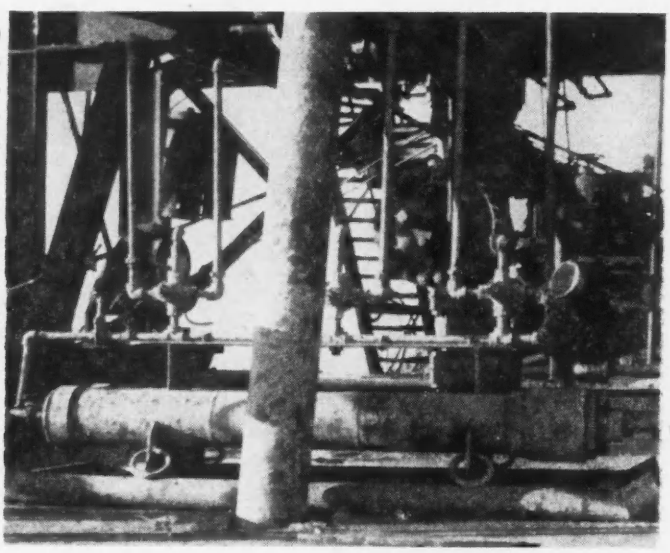
PENBERTHY "Reflex"
WATER GAGE SET

Water level cannot be misread because steam always shows white and water black. U-Bolt construction permits replacing glass by simply removing nuts on face of gage... unnecessary to work between gage and boiler. 3277-D

PENBERTHY PRODUCTS

PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant — Windsor, Ontario

HOW TO—Guard Blowout Preventers



Where mud pump pressure is used to open and close blowout preventers, a simple, effective device may be made of discarded mud pump cylinder liners to keep the drilling mud from contaminating the blowout preventers. This device consists of three cylinders welded together with the inside of the welds ground to a smooth finish. A used mud pump piston is fitted with new rubbers and placed inside the set of cylinders so that it floats back and forth, and seems to separate the water cushion and power mud.

When the blowout preventers are in the open position, the piston is to the left of the cylinder. When mud pump pressure is applied, the piston floats toward the right side of the cylinder as the rams are closed. When the rams are opened, it is necessary only to release the mud pump pressure and apply pressure from the wash down pumps to put the piston back to the left side of the cylinder. For a safety measure, the valve is opened on the mud pump line so that the cylinder is always as far to the left as possible before allowing it to stand in a "ready" position.

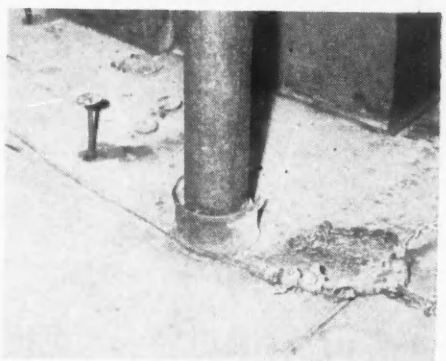
Besides preventing contamination of the blowout preventer equipment, this device also prevents corrosion of the equipment as fresh, soft water is always on the downstream side of the piston.

HOW TO—Prevent Wire Line Hazard

Use of a wire line between cathead and swivel of the spinning line introduces a hazard which is not present when manila line is used—that of the line catching under the lower end of the vertical roller which guides the line and keeps it off the driller's stand. Even when the bearing guard is formed to come close to the lower end of the roller, there is a gap which tends to act as sheave or guide for the catline, wearing the outer wires severely and also tending to make the line jerk dangerously when the strain pulls the line free and it snaps up to cathead level.

One contractor utilizes a casing thread protector as roller guard. A segment just large enough to allow the protector to slip over the roller is cut out, and the portion remaining is welded to the steel grille of the floor in such a position as to encircle the post or roller and bearing and form a smooth surface against which the catline can lie without danger of abrasion or being snagged in the gap.

Since a portion of the gap between roller and support is not covered by the guard, there is no difficulty in maintaining lubricant supply for the lower bearing, as the oil can spout can be introduced through the gap still left open—with the added advantage that the guard not only keeps the catline clear but also deflects most of the dirt and mud on the floor.



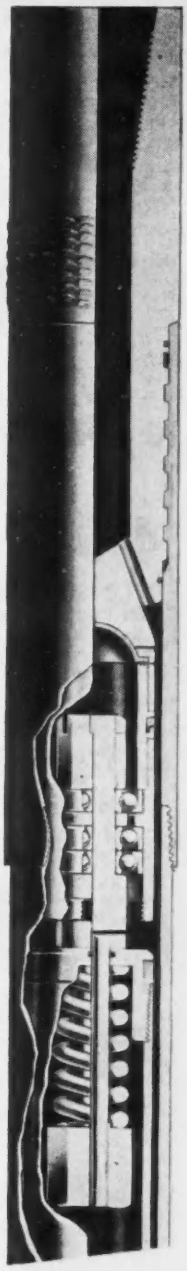
D & S was—

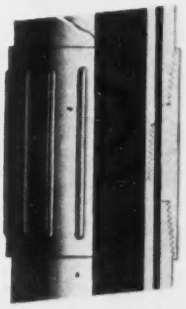
FIRST to make diamonds "pay off"!

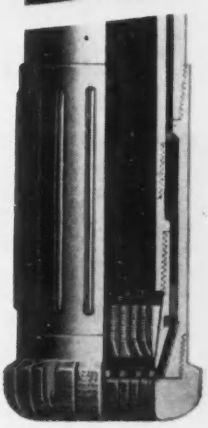
FIRST to devote its efforts 100%

to the development of oil field diamond drilling!

CORE BARRELS • DIAMOND BITS • WASHOVER SHOES • WHIPSTOCK BITS • REAMERS







World-wide Service

Call nearest office below
for information and service

Designed to meet specific conditions!
Selected diamond quality for peak performance!

Drilling & Service, Inc.

3031 Elm Street Dallas 1, Texas

RIverside 6811 • TRemont 5559

Other Offices-Services

Tyler, Texas—2-2742
Odessa, Texas—6774
Abilene, Texas—2-2790
Hobbs, N. M.—822M
Norman, Okla.—4360
Shreveport, La.—5-5474
Casper, Wyo.—3739

Distributors

Diamond Drilling Company
15301 South Avalon Blvd., Compton, Calif.
Telephone: Long Beach 924-84
Allied Services, Inc., Mt. Pleasant, Mich.
Telephone: 29-861

Foreign

D. T. O'Connor, 500 Fifth Avenue, New York, N. Y.
Petroleum Industry Consultants, C. A., Caracas, Venez.
Denton-Spencer Co., Ltd., Calgary, Alberta, Canada.

D & S CORE BARRELS

The model for diamond core barrels

Barrel Patent No. 2,490,512

SUBS

TO YOUR SPECIFICATIONS

IN

4 Days or Less

We keep a complete stock of standard subs for immediate shipment. In addition, we are equipped to make any sub, to your specifications, quick. The entire job as outlined below—from Alloy Bar to finished product, is handled in our own plant, and takes four days or less.

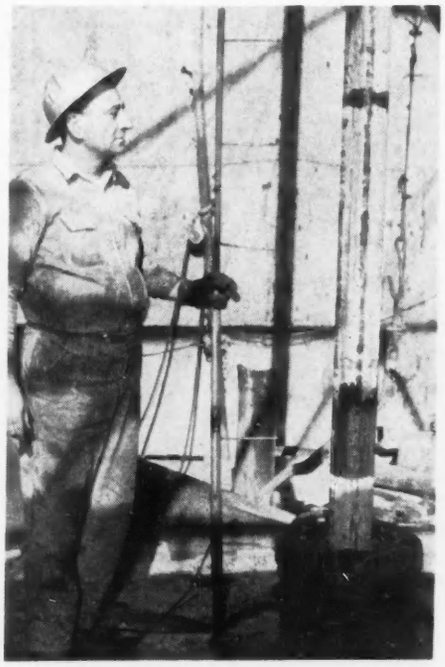
- Alloyed Bar
- Forging
- Machined and Heat Treated
- Finished Sub

For Subs—In a Hurry . . . .

LONE STAR ★ TOOL COMPANY

WICHITA FALLS, TEXAS

HOW TO—Measure Rate of Drilling

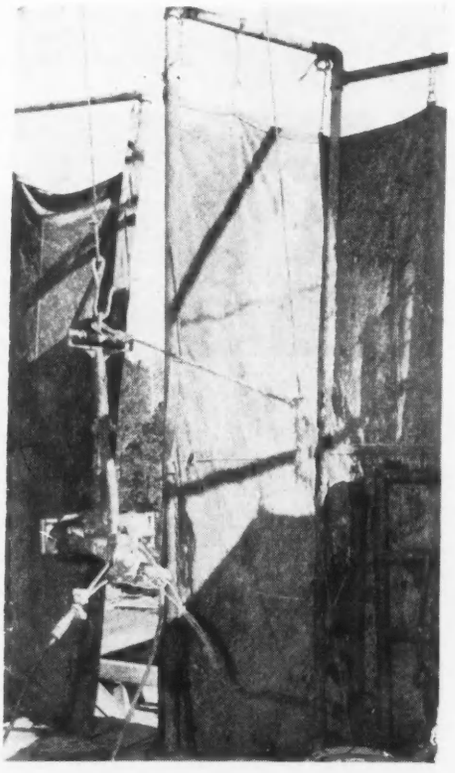


The usual method of checking drilling rate involves the use of a measuring stick, usually five feet long, and markers or rings of joint dope or paint, daubed on the kelly opposite the foot markers on the stick. The progress of these marks toward and into the drive bushing indicates drilling progress.

One contractor uses a unique method of checking progress which involves the painting of but a single ring on the kelly, at the top of the gauging device. This device consists of a broad pedestal, on which is mounted an adjustable standard, carrying six long pins spaced at one-foot intervals. The mark is made on the kelly opposite the uppermost pin, and its progress downward is thus easily checked as hole is made.

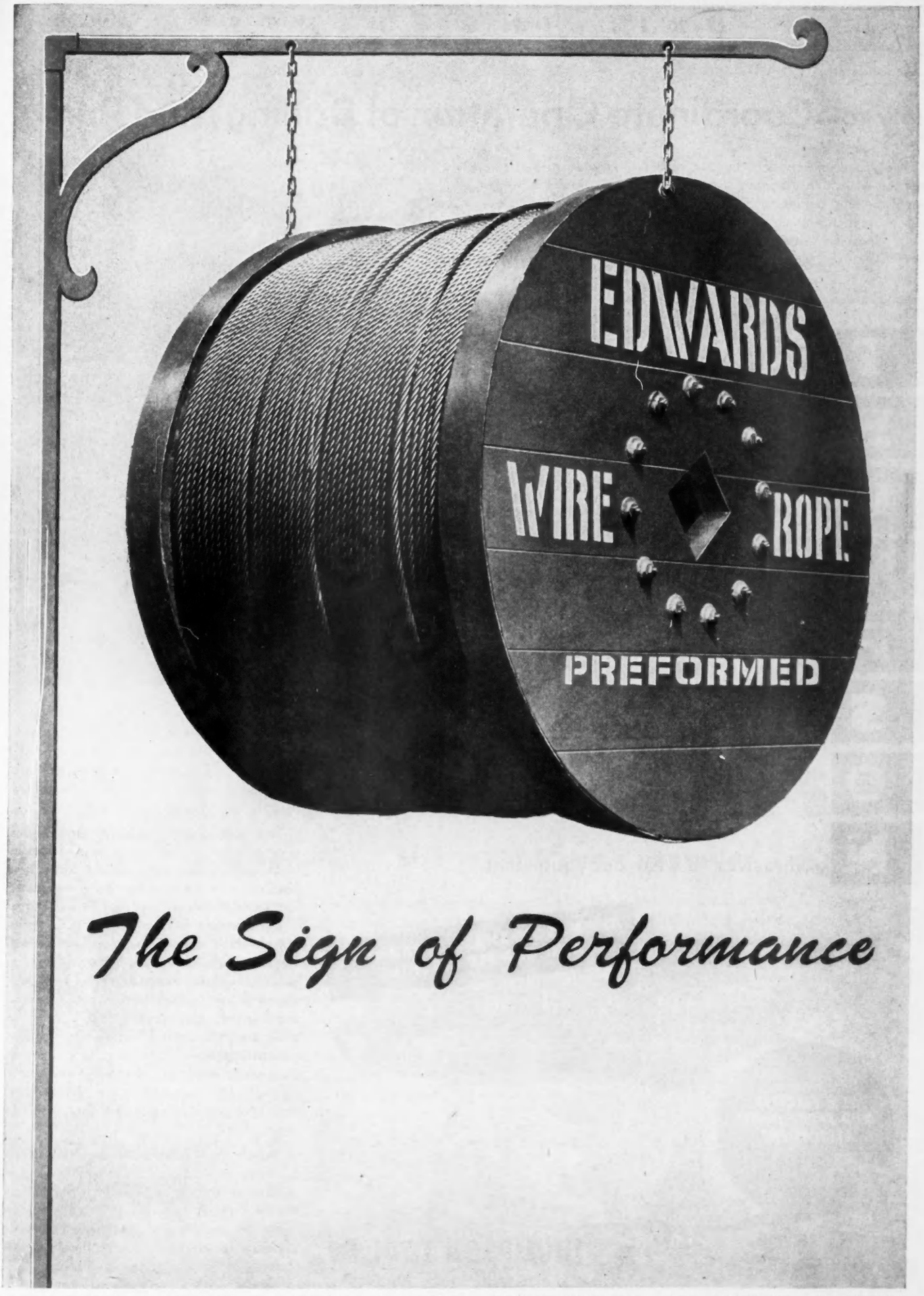
The measuring unit extends out over the rotary table guard, and may be swung out of the way or removed completely, as it simply rests on the floor and the guard casting.

HOW TO—Make Door for Enclosure



Supporting the canvas windbreak across the V-side of the derrick floor requires some method whereby the canvas can be drawn aside when it is necessary to drag pipe onto the floor. One contractor solves this problem by making frames of two-inch pipe which each fill half of the space of the desired opening. These frames are carried in hinges made by reaming out the thread from the run ends of two-inch tees, and then by welding a collar to the upright pipe member at the proper point to provide support.

Canvas is stretched across this frame so that when the door member is opened the canvas is not unduly strained, and when the door is in the closed position the fabric presents an unbroken surface from derrick corner to the matching edges of the doors. With the two doors and canvas applied in this fashion, there is only a narrow area not made windproof when the V is closed off, and need for only one half of the opening to be used except when moving heavy or bulky material to or from the derrick floor.

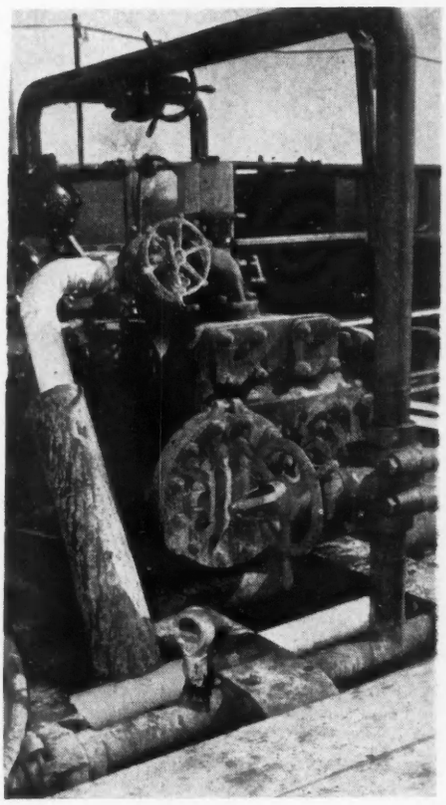


The Sign of Performance

E. H. EDWARDS COMPANY — SEATTLE • PORTLAND • SAN FRANCISCO • LOS ANGELES • HOUSTON

HOW TO—Coordinate Operation of Drilling Mud Pump

Close coordination between the driller and the fireman is essential in many cases where the mud pumps are started, stopped, and a predetermined pressure reached. Since the boiler battery is about 150 feet away from the derrick floor, it is not possible to call back and forth above all the noise. In order that the fireman or the derrickman, as the case may be, will know what is happening, a small mud pressure gauge was installed on the mud line leading to the standpipe. The valve is



near the steam end of the pump nearest the derrick so that the fireman or derrickman may easily see what pressures are developing as he manipulates the steam throttle valve.

The mud pump discharge line passes over the top of the pump, and makes a right-angle bend, and connects through a mud valve to the mud line header. A short section of four-inch mud line bolted to the flanged section of the I-beam skid forms a permanent part of the mud pump unit. Because there is a definite advantage in placing both the steam line and mud line (leading up to the derrick) adjacent to each other, this arrangement proves a time saver in setting up, as well as dismantling the rig. The short mud line, as well as the steam line, has a union connection at each end, and can be attached to the corresponding line on the adjacent mud pump.

Where the steam line to the pump leads up from ground level, it is somewhat of a hazard in that it is possible for members of the crew to sustain burns. To preclude such an accident, a four-foot length of asbestos is wrapped around the line and this is covered with heavy building felt. It is tied with a piece of wire for a temporary setup, which can easily be removed.

T hree sizes for shallow, medium, and deepest wells

H and lever assures simple operation

O perates perfectly at maximum flow or idling

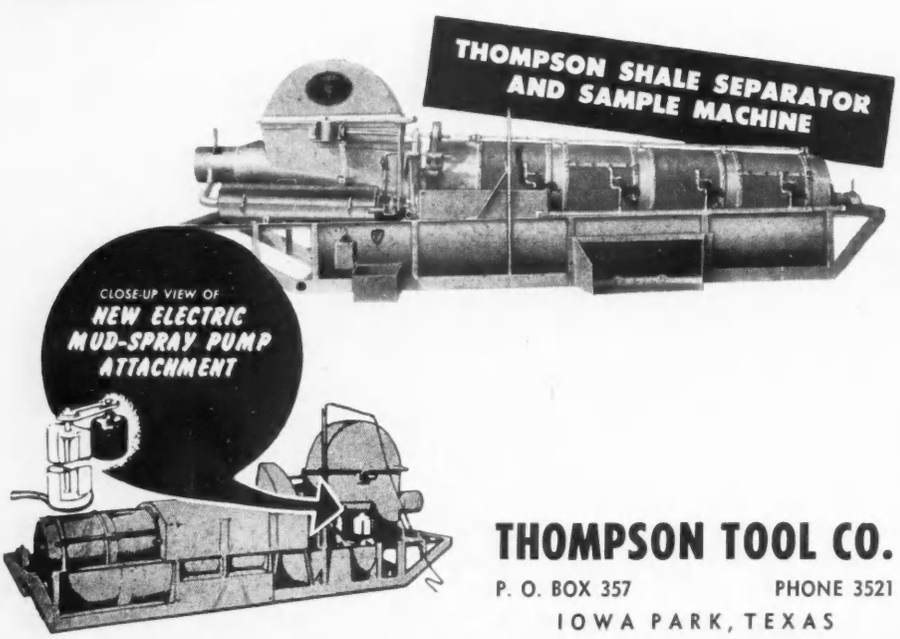
M ore profits - low cost to buy - no cost to operate

P rovides accurate foot by foot cuttings

S ample machine *Provides Accurate Samples*

O nly clean mud goes back into machines

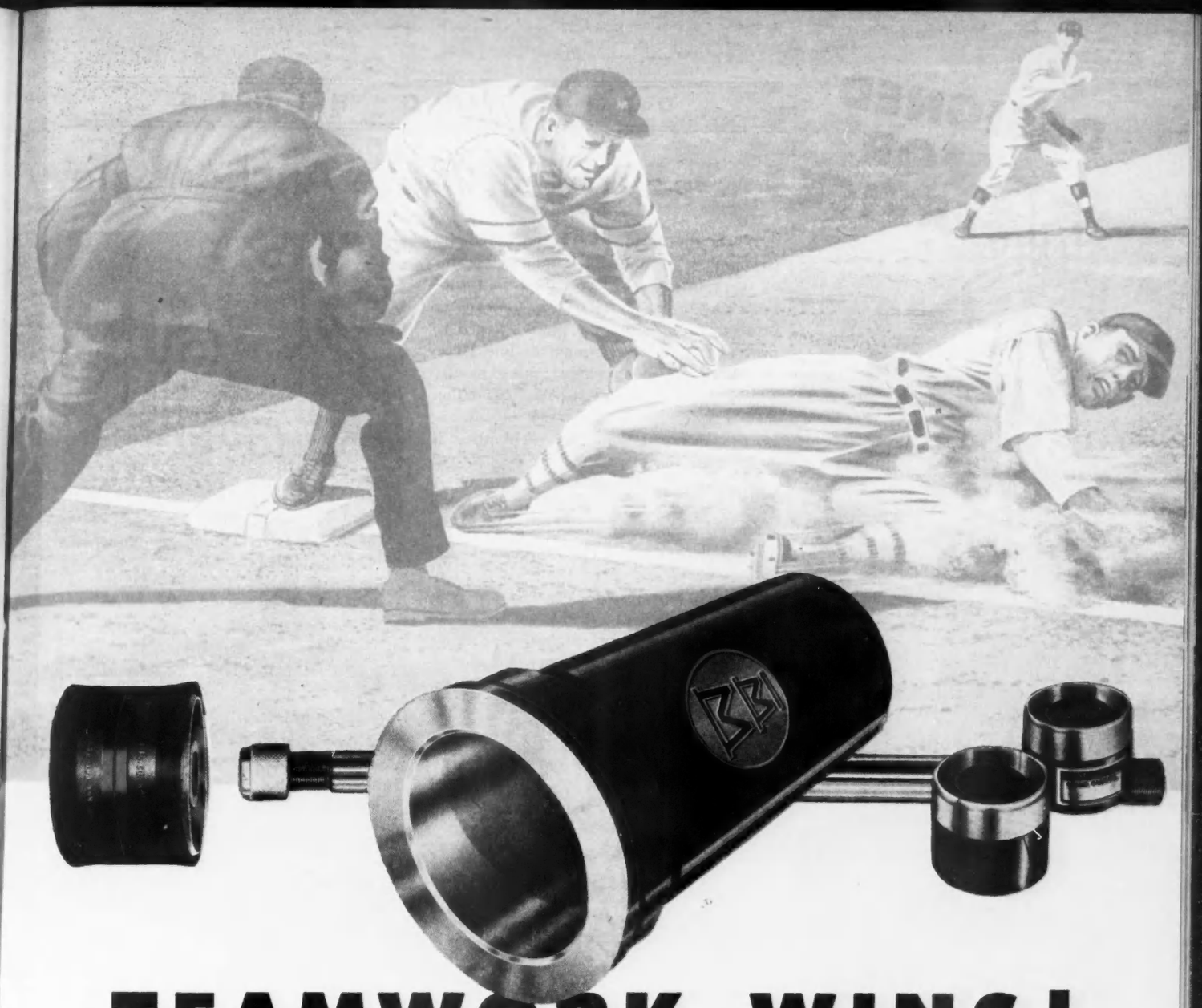
N o abrasives to wear out equipment



THOMPSON TOOL CO.

P. O. BOX 357 PHONE 3521

IOWA PARK, TEXAS



TEAMWORK WINS!

...in baseball...also in slush pump operation

Mission Silver Top Valve for Normal Pressures

Expert teamwork has a fascination for Americans. It is the dominant idea in our sports, our production lines, our democratic government, our efforts for world peace. ***Efficient slush pump operation*** is also dependent on teamwork. Piston, Rod, Packing and Liner must constitute an effective ***team***.

To enable you to obtain MISSION percision and quality in all of these slush pump parts, we have perfected the new MISSION "Super-Service" Liner . . . accurately bored, ***induction*** hardened to ***uniform*** case thickness, precision honed, and "Satin Finished."

MISSION Pistons, Rods, Packing, Liners, and Valves will insure efficient, long-term operation of your slush pumps. Your supply store handles them . . . Mission Manufacturing Co., Houston, Texas. Export: 30 Rockefeller Plaza, New York. Europe: London, England.

Mission Super-Service Valve for High Pressures

"ROLLING DOG" SLIPS
TUBING SWABS
PLUG VALVES
CENTRIFUGAL PUMPS

Silver Anniversary MISSION MANUFACTURING CO. 1951

MISSION MANUFACTURING CO.

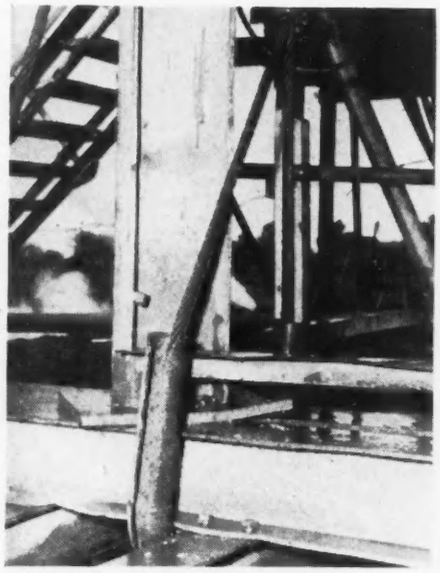
DESIGNED FOR SERVICE

Diamond Core Bits for faster penetration
Diamond Core Bits for full core recovery
Diamond Core Bits for reservoir information
Diamond Wash-over Shoes for fishing problems
SEE OUR CATALOG IN THE COMPOSITE CATALOG
LESS COST PER FOOT
CHRISTENSEN
DIAMOND PRODUCTS

CHRISTENSEN
DIAMOND PRODUCTS CO.
1937 SOUTH 2nd WEST
SALT LAKE CITY, UTAH

HOW TO—Protect Wire Anchor Line

When the dead line is anchored by wrapping it around the foundation beams of the substructure corner post that supports one of the derrick legs, a means of protecting the wire rope must be used to prevent cutting or crimping the line. Here, the dead line is anchored with the wire rope passing under steel I-beam foundation members. These foundation beams are criss-crossed and bolted to each other as well as to the substructure corner leg.



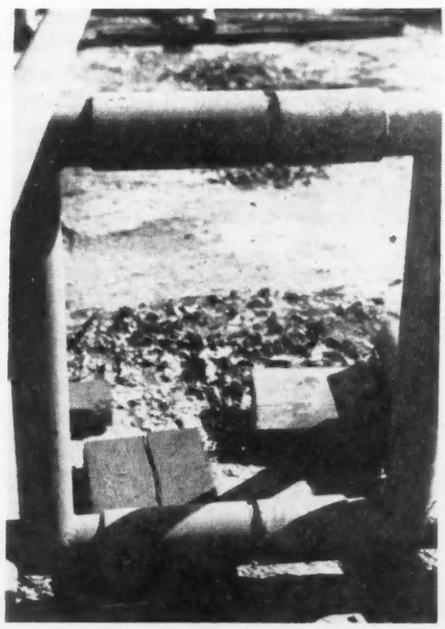
Several pipe fittings are used to fabricate a satisfactory protector ring for the anchor line, and at the same time make its installation quick and simple. Two 90-degree bends and three 12-inch nipples of three-inch pipe provide the necessary materials. The 90-degree bends are welded to each end of one nipple, and another nipple is then welded to the exposed end of each bend so that a large U-shaped tube results.

This tube is then split down the back side by a cutting torch and spread apart so that the wire rope can easily be placed inside. The protecting shoe is wide enough to bear upon the foundation members, yet can be threaded through them after the foundation was laid. In this manner, the wire rope used in the pulley system is not damaged and can be fed on through the system as additional line is needed, whether the line is cut off at the drawworks drum or additional lines are strung up in the derrick.

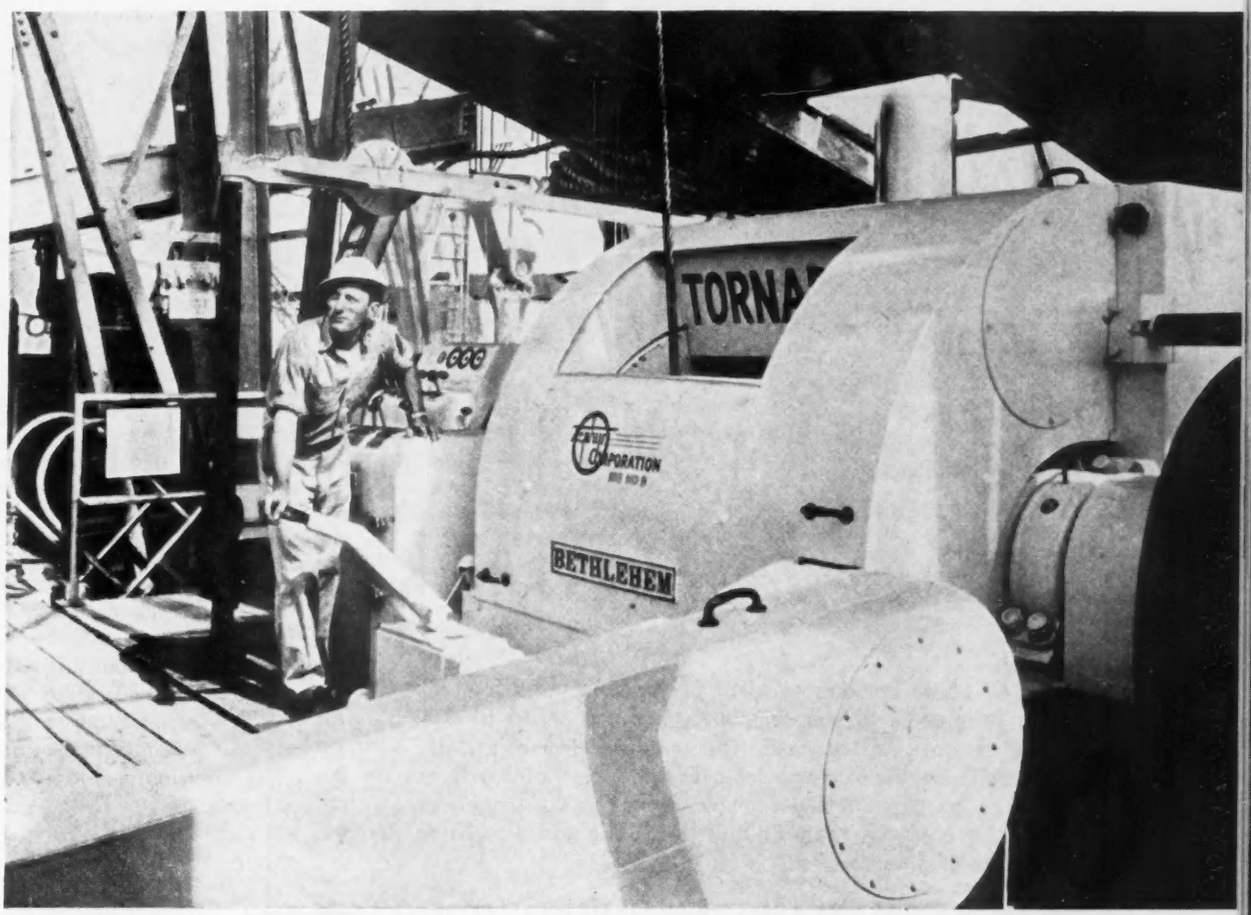
HOW TO—Align Pipe Rack Sections

A method of joining pipe rack sections which assures their being in alignment and without leaving a gap between the ends of the principal members, is employed to good advantage by one drilling contractor. As shown the connection employs the pin and box ends of the drill pipe of which the racks are made, the mating ends being brought together and blocked up in that position. The system is one that is easy to incorporate into the pipe rack when it is built, or discarded or worn tool joints can be welded on to the projecting ends of existing racks. Little or no extra work is required when the units are set up at the well and in fact alignment and levelling of the sections can be simplified through the use of this type of connection.

These pipe rack sections equipped with pin and box ends of worn tool joints are merely butted together to the full extent that the threads of the tool joint will permit. One of the distinct advantages of this method of joining one section with another section of pipe rack lies in the continuity maintained across the top of the rack. The threads of the tool joint, although not made up, will tend to hang on each other in the event that one section of the rack tends to settle, which, in ordinary racks, would form a hump over which the drill pipe must be moved.



How can a BIG rig be so smooth?



That's a common question among drillers who know the Bethlehem Tornado. It's big, all right; a burly, deep-drilling giant with power to burn. Sturdy isn't the word—it's rock-rugged. Yet it is smoother, easier to handle, than many a smaller unit.

The Bethlehem Tornado has power without complicated mechanisms; power so well controlled that the driller's job is easy. Air controls are part of the answer. But other factors enter, one being the self-adjusting, air-actuated clutches. Another is the air-cushioned transmission, which reduces shocks and jolts to the vanishing point.

Before buying your next deep-hole rig, investigate the Tornado. Study the power, smoothness, and flexibility so skillfully blended in this big outfit. Any time you say, a Bethlehem man will be glad to review its features with you, point by point.

BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second Street, Tulsa, Okla.

Subsidiary of Bethlehem Steel Corporation

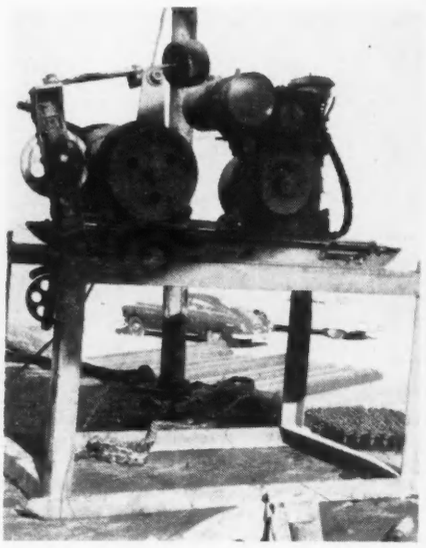
On the Pacific Coast Bethlehem Oil-Field Equipment is sold by Bethlehem Supply Company of California

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

HOW TO—Unitize Measuring Reel for Portability

On many rigs it is difficult to attach a measuring line to the drawworks in such a manner that it may be driven by a V-belt riding on the cathead. A simplified unit and one that can be easily moved by two men may be assembled and unitized on one small skid. The measuring line drum is driven by a light-weight air-cooled gasoline engine that furnishes power to pull the line from the hole. The measuring line, measuring reel and line drum are an integral unit and are bolted on the small skid through holes in the beam flange. The brake used to control the fall of the sinker bar on the measuring line is on the opposite side of the drum. The counter and calibrated wheel are mounted on an extension arm that is counterweighted to facilitate the job of guiding the wire line on the drum when reeling in the line.



Both the drum and the crankshaft of the engine have V-belt pulleys so that a belt can be used to power the drum when coming out of the hole with the line. When lowering the sinker bar and line into the well, the belt is left off. To maintain tension in the V-belt when it is used, an idler wheel is mounted on an offset arm so that the wheel rolls on the inside edge of the V-belt and the weight of the wheel takes up the slack in the belt and eliminate excessive slipping.

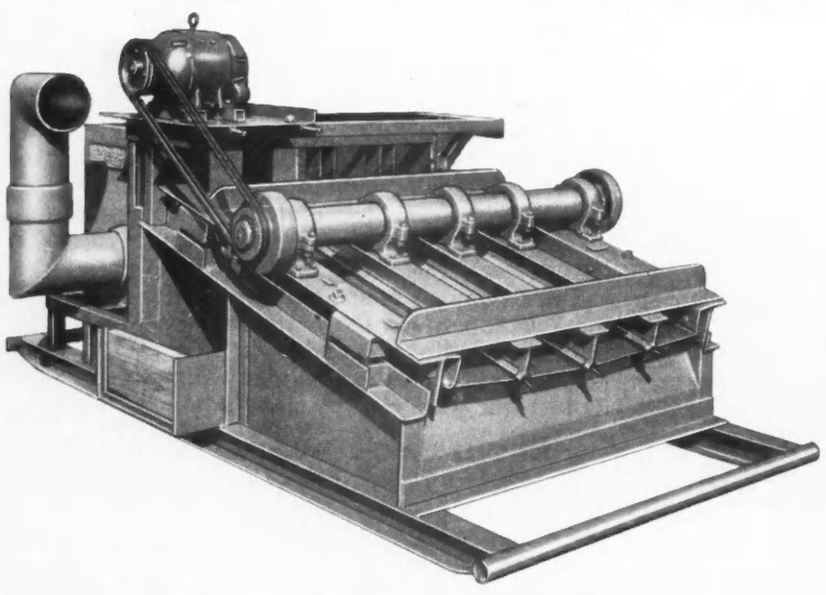
The small I-beam skid has four handles bolted to the web section of the beam near all four corners of the unit. These handles are of rod steel material, with the ends flattened and drilled so they can be bolted to the beam as shown. Each end of the skid members are curved upwards so the unit could be loaded easily on trucks or handled about the rig floor. An angle iron bench about 30 inches high is used on this installation to place the measuring line unit at a convenient height to operate.

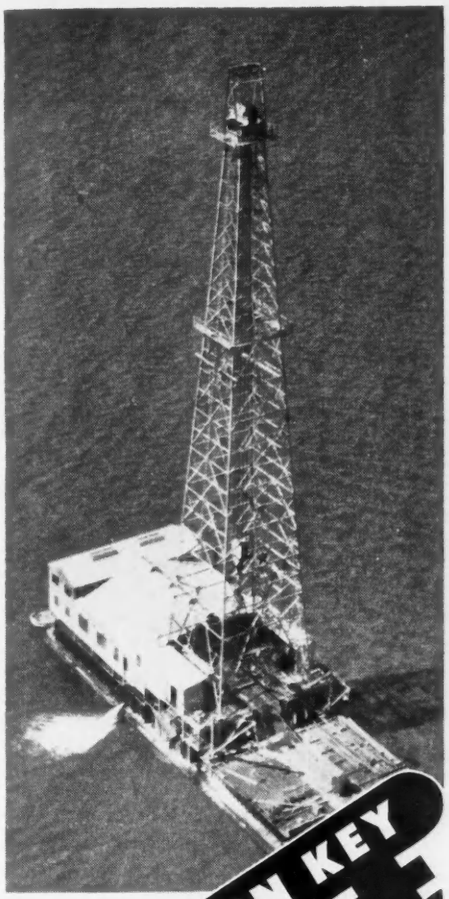
ITS RUMBA ACTION
REMOVES SAND AND SHALE
BY NEW FLOTATION PROCESS

...AND SCREEN CLOTHS LAST MORE THAN A YEAR!

"RUMBA" Shale Shakers excel in performance and low cost maintenance. They come to you completely unitized on 10 ft. skids . . . no rigging up costs in the field. The underslung screen cloth, with no obstructions on the bottom, removes sand by floating it out on the bottom of the cloth. This design contributes to the longer screen cloth life . . . one of the features that is causing the worldwide demand for "RUMBA" Shakers.

HUTCHISON MANUFACTURING COMPANY
6609 AVENUE U • HOUSTON 11, TEXAS





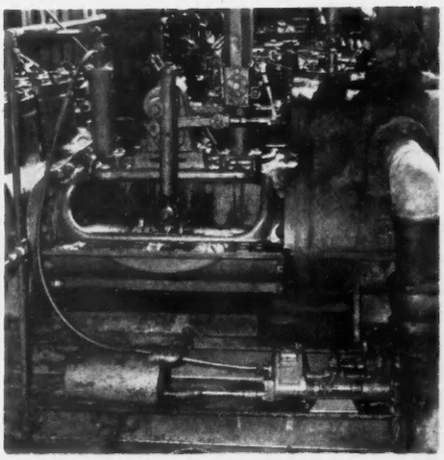
LET
Levingston
DO THE COMPLETE JOB
with the machinery of your choice

From crown block to barge bottom, Levingston is prepared to accept the entire responsibility of constructing and rigging-up your submersible drill barges on a turn-key basis. You select the tools or equipment, and Levingston's experienced organization will install them for safe and efficient operation on marine locations.

Levingston
SHIPBUILDING CO.
Orange, Texas

DRILLING HINTS

HOW TO—
Mount Piston Rod Lubricating System



Careful consideration of the location of piston rod lubricating equipment can eliminate many headaches in the maintenance of this equipment. Experience in operating heavy-duty mud pumps shows that proper care of rods pays dividends in increasing rod life. Special lubricants have replaced water for this purpose, and while this practice has considerably reduced rod replacements, it has brought about an additional problem in equipment upkeep.

The installation shown has proved its worth in providing efficient lubrication of the piston rods with a minimum of attention and a great saving in setting the equipment in place originally. A problem on installations of this type is where to place each item so that a minimum of space is taken up and at the same time easy access for maintenance work is provided. The lubricating system illustrated can be made a permanent part of the pump skid, or can be removed each time the pump is moved. It consists of a small steam-powered pump, of 2¼ x 3½-inch size, mounted on top of the web formed by the heavy I-beam skid runner. It discharges through a long flexible, oil-resistant rubber hose connected to a receiving chamber mounted between the pump cylinders and above the rods.

A galvanized sheet metal collection pan spanning the pump housing below the rods and about three inches deep takes care of all overflow of oil. A sump chamber made of a 14-inch section of six-inch casing sealed at both ends is placed on the skid runner at the level of the lubricating pump. A drain line connects the collection pan with the top of the sump and thereby insures flooding of the pump suction. By arranging the rod lubricating equipment in this manner, complete access to the rods and cross arms is possible.

It Pays to Use...

Strata-Crete
TRADE MARK

...an aggregate to lighten your cement slurries

More and more oil men are discovering that cement slurries made with Strata-Crete give them these four valuable benefits — at low cost.

1. Strata-Crete substantially lightens the cement slurry.
2. With Strata-Crete, higher columns of cement can be pumped with lower pressures.
3. Strata-Crete with cement facilitates perforation.
4. Strata-Crete helps materially to reduce lost circulation of cement.

Strata-Crete is used with high early, slow set, or standard oil well cement. It is available through leading oil well cementing concerns.

Strata-Seal
TRADE MARK

to combat lost circulation of drilling mud

Recently made available to the oil industry, Strata-Seal has already proved to be one of the most highly effective, *practical* developments to combat lost circulation and returns.

So effective is Strata-Seal's bridging action, that even in a number of extreme cases, it has restored circulation and saved abandonment of wells.

Check these advantages

1. Strata-Seal protects investments by making possible reclamation of wells about to be abandoned.
2. Eliminates or reduces rig down time.
3. Savings resulting from ability to screen.
4. Has no detrimental effect on viscosity, water content and gel strength of drilling fluid.
5. Is easily added to mud.
6. Does not interfere with coring operations.

Available through leading mud service companies.

Sales Offices in Principal Oil Centers

SEND FOR SAMPLE VIALS NO OBLIGATION

Feel the lightweight. See the uniformity.

GLC **STRATA-CRETE SALES**

Great Lakes Corporation, Dept. 24
5845 Atlantic Ave., Long Beach 5, Calif.

Please send sample vial and technical data on

☐ **Strata-Crete** ☐ **Strata-Seal**

NAME.....
COMPANY.....
ADDRESS.....
.....

Simplex-Jenny
PULLING VALVE SEAT

PULL FASTER and EASIER

Simplex Center-Hole Jennies use hydraulic power for quicker pulling of valve seats, gears, wheels—scores of other oil field jobs. Operate in any position; light weight, quickly set up. 6 models: 30 to 100 ton Capacities.

Simplex
LEVER · SCREW · HYDRAULIC
Jacks

Send for Bulletin: Oil 49

TEMPLETON, KENLY & COMPANY
1032 South Central Avenue, Chicago 44, Illinois

KERN
DIRECTIONAL DRILLING CORP.

- SIDETRACKING
- STRAIGHTENING
- CONTROL DRILLING
- CONSULTING

HOUSTON: P. O. Box 8055
Phone: KEystone 6123

ABILENE: G & L Tool Company
Phone: 5555

CORPUS CHRISTI
Specialties Warehouse
Phone: 3-4488

PRINTED FORMS

Immediate delivery of producing and pipe line forms made from our complete line . . . Write for completely illustrated catalog.

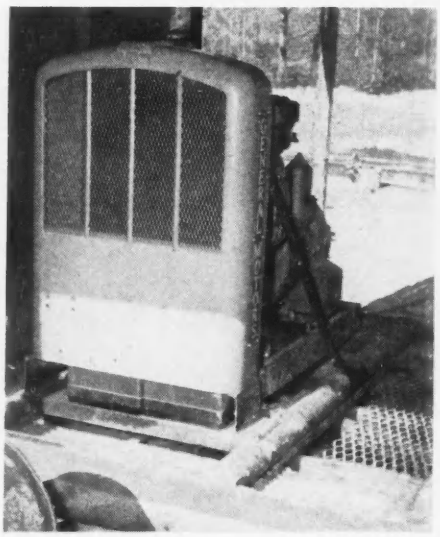
GULF PUBLISHING CO.
P. O. Box 2608 Houston 1, Texas

HOW TO—Install Auxiliary Units

One contractor mounts the two generator units on rectangular frames of three-inch pipe, making the bases just long enough to fit within the edge angles of the space set aside for the power plants in the end of his all-steel mud house.

To locate the units and prevent lateral shifting under running vibration, a short section of four-inch channel iron is welded to the steel floor in such a position that one side member of the pipe sub-base fits into the channel when the generator unit is properly spaced.

Unions in the fuel lines to the engine driving the generator and a slip connector on the leads carrying the power to the rig distribution circuits are the only joints which must be broken when a generating unit is to be removed for transportation to the shop for servicing.



When a unit is to be exchanged, it is necessary only to attach a truck winch line to one of the pipe frame, lift it slightly so as to pass over the edge member of the mud-house frame, and slide the unit out to where it can be lifted free. Placing a second unit requires only that it be slid into the space just vacated, the only care being to see that the frame member of the generator unit base fall into the aligning channel, as then both fuel lines and circuit connectors fit without forcing.

Free Your "Hands"

for other important work . . . use

GEOLOGRAPH

MECHANICAL WELL LOGGING SERVICE

Geolograph gives you accurate drilling time, guide for bit change, round trip time and shut-down time. Reduces number of failures in drill stem testing! This data — and more — you get with Geolograph — while, at the same time, it frees your "hands" for other important work!

HOUSTON, ODESSA & WICHITA FALLS, TEX. • CASPER, WYO. SHREVEPORT & BATON ROUGE, LA. • BAKERSFIELD, CALIF.

"TIME WILL TELL"
THE GEOLOGRAPH CO. INC.
P. O. Box 1291 Oklahoma City 1, Okla.

Factors in Well-Servicing Costs

Snapup wrenches provide the necessary impact for setting or breaking out rods without the hazard of nicks, chipping or other damage.

By W. E. BEST

OIL wells are not usually serviced until the capacity of the well is off, or below its normal rate of production from some reason or other, such as parted rods, pump sanded up or gas locked, cups cut, valves leaking or tubing leaking, and the well reported as off by the pumper to his foreman. Sometimes a well is not serviced for several days after the pumper has reported it as off. If the well is of high capacity, this neglect can be expensive.

The cost for servicing a well depends on a number of very important factors: (1) distance from well servicing unit yard to well; (2) kind of roads to well location; (3) depth of well; (4) whether well has derrick or not; (5) if permanent deadmen for guy lines are installed over wells over which there is no permanent derrick; (6) type of well servicing job.

These factors are very important, particularly if the oil operator contracts his well servicing work, for which he pays on an hourly basis for equipment and men furnished to perform the job. The cost of well servicing work performed by contractors begins from the time the well servicing unit leaves the yard for the well. The job performance costs include road time from yard to the well, rigging up time, job performance time, rigging down time, any waiting time incurred through fault of the operator, such as waiting for sucker rod replacement, tubing replacement, pump repair or replacement or waiting on orders, and waiting time to be sure well is pumping, or to respace pump or tubing.

WELL SERVICING as it pertains to the servicing of rods, tubing and the subsurface equipment in an oil well is the most important and necessary service that affects operating costs in the production of oil. The neglect of proper and timely well servicing can mean the loss of production with resulting loss in revenue and increased lifting costs.

Derricks vs Masts

Wells over which permanent derricks are erected can be serviced with less required job performance time than those which must be serviced with a mast, as the derricks are tall enough to permit pulling the tubing and rods in doubles and standing them back; whereas the conventional mast, either single or double pole, is only tall enough to permit the pulling of rods and tubing in singles which must be laid down on a rack instead of being stood back as in a derrick.

Present highway weight laws have made it difficult to design a well servicing unit equipped with a mast tall enough to permit pulling rods and tubing in doubles.

The installation of permanent deadmen for the mast pole guy lines at those wells over which no derrick is erected will save considerable time in rigging up and will return the cost of installation many times throughout

the life of the well. Permanent deadmen are much safer than stakes which present the hazard of pulling out of the ground, and which also must be driven and pulled from the ground when the job is complete.

Well servicing work can be broken down and classified in several types of repetitive jobs: rod job for the purpose of fishing rods; pump change; tubing leak; rod and tubing jobs, such as a stripping job; and cutting paraffin and shake-up jobs for sanded up or gas-locked pumps.

Fishing rods is one of the most frequent of all well servicing jobs, especially in deep wells which are heavy pumpers. This job consists of pulling the rods down to the break or part and rerunning with a socket or rod splicer and taking hold of the rods still in the hole. Excessive paraffin in the tubing necessitates cutting and cleaning the paraffin from the tubing before a rod socket or fishing tool can be run and will extend the time required for the job by from one or more hours, depending on the amount and hardness of the paraffin deposition in the tubing. The use of paraffin scrapers or scraper couplings on the upper 1500 or 2000 feet of rods will greatly reduce the paraffin deposition in the tubing.

The necessity of changing the pump in a well probably occurs more frequently than any other type of well servicing job, as many times the pump is changed at the same time a well is serviced for a rod job. Again as in the case of rod jobs, paraffin deposition in the tubing slows up the work and increases the amount of time required to perform the job. In many instances in wells in which paraffin scrapers are not used, and the well service crew does not take the time to cut paraffin before pulling the pump up into the section of paraffin deposition, the pump becomes stuck and necessitates a stripping job. Another factor that increases the cost of a pump change is the waiting time incurred because the operator does not have a spare pump available, and the operator has to pay waiting time on the crew and unit while the pump pulled from the well is taken to a shop and repaired. Occasionally the waiting time alone would pay for the spare pump.

Rod and Tubing Jobs

This classification covers all well servicing jobs where it is necessary to pull rods and tubing for various reasons as; stripping jobs, to change mud anchor, change pump jacket, change seating nipple or for any reason other than tubing leaks. Stripping jobs are the most damaging of all rod and tubing jobs and result by the pump becoming stuck. Much damage to rods could be reduced and time saved if a safety joint were run on the rods above the pump which would permit pulling the rods first and then pulling the tubing to get the pump.

The classification tubing leaks covers those well servicing jobs where rods and tubing are pulled on account of leaky tubing due to split joints, bad collars or holes caused by corrosion. Leaky tubing can result in large volumes of lost production if the pumper does not detect and report it soon enough. Tubing leaks which are due to bad collars can usually be charged to abuses, such as hammering on the collars when breaking the joint, use of spinning rope, not making the joint up tight enough, dirty threads, careless handling of the threads, and improper use of the thread lubricant.

The advent of the eight-round thread joint has done much to minimize tubing collar leaks. The newly developed air tong should reduce thread damage as make-up torque is the same on every joint. Also, in pulling and running in doubles, alternating the breaks every time the tubing is pulled will greatly prolong thread life.

Paraffin deposition in tubing is probably the toughest problem in maintaining wells at capacity, both in pumping wells and flowing wells. It has been found that the use of paraffin scrapers will greatly reduce paraffin. However, it is necessary to pull the scraper rods from the well occasionally and steam off the paraffin. It is also necessary to pull the tubing occasionally and steam the paraffin from it.

Shake-up jobs are those where it is necessary to unseat the pump and flush the tubing on account of sand, to shake up the plunger also on account of sand, or to bump valves due to gas lock, or to respace valves.

Table 1 shows an analysis by the writer of Oklahoma's largest well servicing contractor's operations, and covers only the work performed in the Oklahoma City field where all wells are equipped with derrick and depth is 6000-500 feet. The analysis was prepared from invoices rendered customers for 1947, 1948 and 1949. The analysis was made without discrimination and includes all jobs performed and reflects an over-all average. The unit time hours include road time to well, but man hours represent actual time to perform job, including rigging up time, rigging down time, and waiting to see if well will pump. (The pump change classification includes those jobs where rods were fished before pulling pump, which naturally reduces the number of jobs performed for fishing rods.)

TABLE 1

Kind of Job	Total Number of Jobs	Average Hours Per Job	
		Unit Hrs.	Man Hrs.
Round Trip Fluid-Powered Pump	66	15.55	56.90
Fish Rods	901	4.79	13.25
Pump Change	929	6.94	18.92
Tubing Leaks	103	29.29	98.33
Rods and Tubing	156	24.32	81.66
Cutting Paraffin	114	5.07	13.46
Shake-up Pump	114	3.73	10.04

Extent to which paraffin can clog well is demonstrated by this accumulation, shown as it oozes into waste pit as well is being steamed out. Originally deposited more or less uniformly around the tubing wall, the plastic material forms plugs as it is forced through piping by steam pressure.

In summary, much money can be saved with increased revenue from production if the operator will study his well servicing costs and operations.

"Bradford Practices"

In California Water-Flooding

By W. H. SOMERTON
University of California, Berkeley, Calif.

APPLYING SO-CALLED "Bradford practices" to water-flooding operations in California fields is highly injudicious in view of marked differences between the areas. The author points out such differences and suggests more suitable methods for successful application of water-flooding California oil sands.

PROMISE of a greater demand for California crudes, particularly for the heavier grades, is focusing the attention of operators on the possibilities and development of secondary recovery methods. Research and experimentation are continually advancing, with new activity noted particularly in the field of water-flooding. The full scale application of water-flooding may be deferred for a time but its application in the near future to offset declines in the discovery of new reserves and stabilize the supply of crude oil is inevitable. More favorable market and price conditions for higher quality crudes may lead to increased water-flooding activities at an early date in fields producing oil of this type.

If the application of water-flooding methods in California is somewhat delayed, it will be to the advantage of California operators who are not prepared to launch full scale projects of this type. There is insufficient experience and know-how in California at present to risk such attempts. Failure of hastily developed projects would only add to the prejudice against secondary recovery which has not yet been fully overcome in this state.

When water-flooding operators moved into the Mid-Continent region and attempted to water-flood employing the so-called "Bradford practice," many failures occurred. These failures were a result of applying methods which were commonly accepted and approved for one area, without taking into account the vast differences in reservoir conditions which existed in the new region. The same problem will arise when attempting to adapt Mid-Continent practices to California conditions. The differences are greater between the latter two areas than between Bradford and the Mid-Continent. Certainly many lessons can be learned from the experiences gained in other areas but California operators must develop many completely new techniques to be successful in water-flooding. An attempt is made in the following discussion to review some of these problems in light of past experience.

Company Organization

It is common knowledge that, in general, small companies have been more successful in water-flooding than large companies. This is of particular significance to California where the proportion of major companies is greater than in most other areas. The success of small operators can be attributed to several factors. The small operator is of necessity more economy-minded than are the major companies, and he generally has a much smaller overhead which adds to this economy in operation. It appears that the majors could learn a valuable lesson in what might be termed "secondary recovery economics." This is a special field of study where cutting corners without neglecting basic principles leads to the reduction of costs. The entire engineering and operating staff involved in secondary recovery should be impressed with the importance of this requisite for successful operation.

Secondly, the small operator has a degree of flexibility as far as operating practices are concerned which is not approached by the majors. If need for a change in injection rates or pressures, in input or production wells, water treatment, or any of a host of other operating practices becomes apparent for the successful operation of the flood, the small operator can make these changes on the spot.

A major difficulty in organization is the attempt of companies to convert primary production personnel to secondary recovery personnel without due indoctrination into the intricacies of this special engineering application, for projection of primary recovery principles to secondary recovery may lead to disastrous results. A heartening trend has been noted toward the formation of separate departments of the company organization for the sole purpose of handling secondary recovery operations. If this department is given sufficient freedom in its operations and is staffed with secondary recovery-minded individuals, all of the above problems can be readily solved. Although this trend has not been noted in California because of the limited application of secondary recovery, its timely institution would be desirable.

California's Reservoir Conditions

When nature endowed California with thick, comparatively permeable reservoir sands, she offset some of the inherent disadvantages (as far as water-flooding practice in other regions is concerned) with comparatively steeply dipping formations. Up-dip flooding, rather than the intensive blanket flooding employed elsewhere, may prove highly advantageous. This method involves the location of injection wells down the flank of the structure at or near the natural water-oil boundary and subsequent moving of the oil to up-dip producing wells taking full advantage of natural

gravity segregation of the fluids. This in a sense is but a process of floating the oil to up-dip wells and should minimize bypassing which would readily occur in attempting to drive the oil horizontally through thick, highly permeable and highly variable formations.

The greater permeability and the greater lenticularity of California reservoir sands in comparison to other regions will impose added problems. Where Mid-Continent sands may have an average range of permeability between 50 and 150 millidarcys, many California sands have permeabilities of several hundred millidarcys. To inject an equal volume of water per foot of sand thickness into California's sands would require considerably less pressure than in the Mid-Continent. Thus it would not be practical to determine injection pressures on the same basis as used in other areas if any degree of control over the flood water is to be attained. Closely allied to this problem is that of the reportedly higher viscosities of California crudes in comparison to those found elsewhere. Although there is considerable question as to how significant this difference is when considering viscosity under reservoir conditions, it is apparently a problem to be considered. High permeabilities and high oil viscosities lead to a lack of stability of any water-oil interface which may be developed. Since an extensive interface in the form of a bank of oil ahead of the water probably does not exist as such in the reservoir, it is perhaps better to consider that water will have a greater tendency to bypass under these conditions. Although this may be difficult to avoid, it can probably be minimized by maintaining injection rates at a low level and taking the fullest advantage of gravity segregation.

Because of the erratic and complex nature of California reservoir sands, a great deal of subsurface information will be required in developing the flooding program. Mid-Continent operators have relied to a large degree upon core analysis to disclose variations in sand properties and variations in fluid saturation. The information so derived is very helpful in outlining selective shooting, plugging, and injection programs and in the completion of producing wells. However, coring is expensive and other means of obtaining equivalent information at a lower cost should be explored. The greater depth of California reservoir sands will probably dictate the maximum possible use of old wells for the flooding program which in itself will limit the amount of coring information which will be available. The use of radioactivity logs in these existing wells may be a partial solution to the problem. The possibilities of quantitative interpretation of radioactivity logs have been reviewed in the literature[1] and when employed in conjunction with electric logs and core analyses of new wells should be very helpful in deriving this essential information.

Thus it becomes increasingly apparent that the injudicious application of Mid-Continent practices may lead to unsatisfactory results. Considerable directly applicable assistance, however, should be forthcoming from the closely allied practices of pressure maintenance by water injection and water disposal. Much can be learned from the water disposal project in the Greeley field, California, pressure maintenance and water disposal work in the Magnolia field, Arkansas, and many others.

Water Treatment

Many technical articles dealing with the treatment of injection water have appeared in the literature in the past several years. A great deal of controversy exists as to the type of water which should be used for injection and the most desirable treating method. Since water-treatment facilities often represent a large part of the total capital invested in a water-flooding project, it is extremely important that water treatment be given considerable attention.

The trend in recent years has been toward the use of saline waters for injection and preferably water produced from the same zone or a zone similar to that being flooded. The trend is likewise toward the use of closed treating systems rather than open systems. The value of the first can hardly be disputed and the second may be noted as an encouraging trend. Open treating systems appear to be contrary to good operating practices for a large share of the cost of treatment results not from the nature of the water itself but as a consequence of the method of handling the water. The water is first aerated; the results of aeration, however, are perhaps not sufficiently valuable to offset the necessity of later deaeration. The water is stored under conditions which may actually be conducive to the formation of algae and bacteria. After treatment to remove these harmful substances, the water is then stored preparatory to injection in clear wells, where conditions are again favorable for the growth of more algae and bacteria. In addition, this writer has seen many well planned water treatment plants where laxity of subsequent operation has completely nullified any beneficial effects of the treatment.

California operators will do well to carefully study this most vital problem. There are at least indications to show that a minimum of water treatment will be required in California. The experience in the Greeley field where treatment of disposal water was discontinued when the capacity of the treating plant became inadequate with no apparent effect on the injection wells, bears out this contention. It does not seem logical that produced water handled in a closed system should require any but a minimum of treatment. It is also questionable whether a small amount of precipitable material in the water would hinder injection wells in high permeability sands. In this connection, unsuccessful attempts to purposely plug highly permeable sands could be cited. And finally, if plugging to a degree sufficient to hinder water injection should occur, perhaps money could be better spent on the development of well-cleanout methods rather than expensive water treatment facilities. The only water treatment necessary may be that needed to minimize the corrosion of injection equipment, and even this might be eliminated by the application of corrosion-resistant coatings to such equipment.

Perhaps the only final conclusion which can be reached from the above discussion is that if water flooding is to be successfully applied in California, it will require considerable field and laboratory research and perhaps a few failures. By taking full advantage of past experience, yet carefully considering the differences in conditions encountered, the probability of success will be increased.

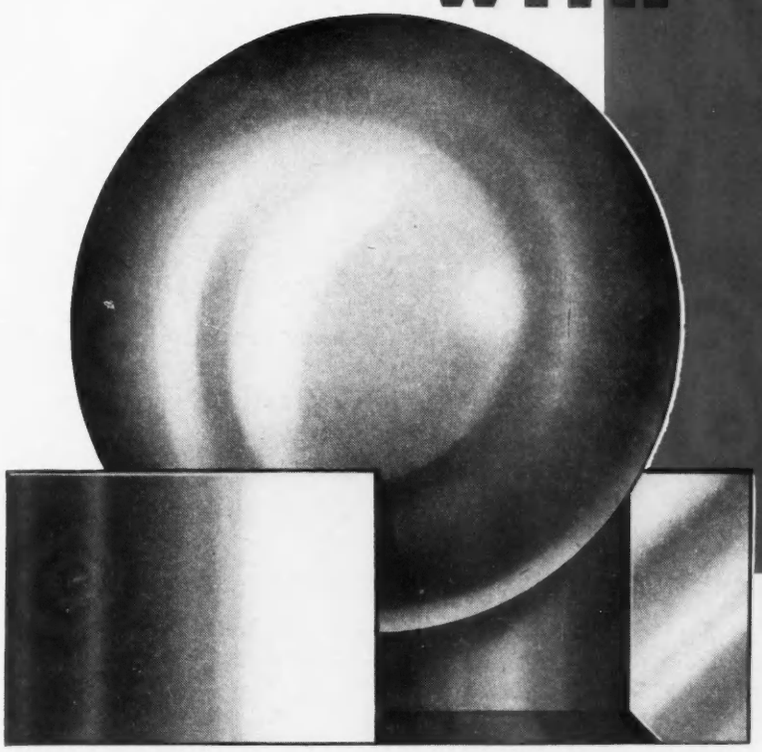
EDITOR'S NOTE: *It is interesting to note that water injection for purposes of disposal and/or water drive has recently been stepped up in California. The California Conservation Commission reports water injection in the following fields: Richfield, Torrance, Dominguez, Lost Hills, Edna, Cat Canyon (West), Barnsdall, Shields Canyon, Rio Bravo, Cato Ridge, Lompoc, Greeley, Del Valle, Simi, Torrey, Canyon and West Mountain.*

REFERENCE

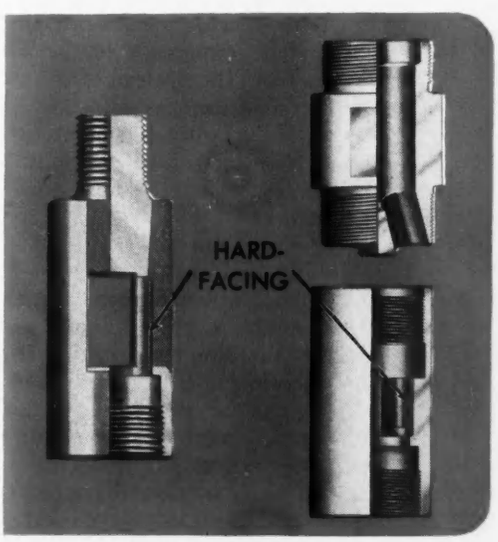
[1] Bush, R. E., and Mardock, E. S., "Some Preliminary Investigations of Quantitative Interpretations of Radioactivity." AIME Jl. Petr. Tech. Vol. 2, No. 1, p. 19 (Jan.) 1950.

Troubled with

- corrosion?
- abrasion?
- ball pound?
- high pulling cost?



OILMASTER TUNGSTEN CARBIDE SEATS AND BALLS are made from solid tungsten carbide, *the hardest metal known to Industry*. These seats and balls will not cut from fluid wash when subjected to extreme pressures—will not wear from the abrasive action of sand—will not hammer out from extreme fluid pound—will not pit from the action of corrosive well fluids. This ball and seat combination provides the most perfect valve ever built.



OILMASTER TYPE 100 CAGES are fabricated from *highest quality chromium alloy non-corrosive steel*. The Ball Guides are hard faced with Tungsten Carbide, assuring perfectly guided valve action for the life of the pump. The blind or closed Cage is of two-piece construction providing maximum adaptability and economy.

oilmaster
Tungsten Carbide Seats and Balls
and
oilmaster
Type 100 Cages

Especially Designed To Eliminate Pulling Jobs Caused By Valve Or Cage Failures

If you are troubled with these problems, your OILMASTER representative will prove that OILMASTER Tungsten Carbide Seats and Balls and Type 100 Cages will lower your lifting costs.

FPPC OILMASTER PRODUCTS

FLUID PACKED PUMP COMPANY • LOS NIETOS, CALIFORNIA

DISTRIBUTED BY THE NATIONAL SUPPLY COMPANY • EXPORT: THE NATIONAL SUPPLY EXPORT CORPORATION, 30 ROCKEFELLER PLAZA, NEW YORK

CO-DISTRIBUTORS: BERRY SUPPLY STORE, BEACON SUPPLY COMPANY, INDUSTRIAL SUPPLY COMPANY

Corrosion Mitigation

In the North McCallum Field

FIGURE 1. Carbon dioxide gas blowing from fissure about 75 feet from a well after tubing and casing had corroded through.

By

C. C. FRYE
Regional Petroleum Engineer

W. L. GIEZENTANNER
Petroleum Engineer

and

FRED M. CLEMENT
Assistant Regional Manager
Continental Oil Company, Denver

Part 1

THIS report covers efforts and results in combating corrosion at Continental Oil Company's North McCallum field, seven miles northeast of Walden, Colo., at an elevation of 8200 feet.

Ten productive wells have been completed in the field, developing about 2000 acres. In October, 1948, three wells were being produced, three served as injection wells, three wells were shut in because of inability to produce against the plant pressure of 800 pounds per square inch, and the remaining well was shut in because of parted casing.

Production is from the Dakota and Lakota sands at a depth of approximately 5200 feet. Each well currently produces an average of 8 MMcf of gas and 125 barrels of 47 API gravity distillate daily. All stripped gas is being returned to the reservoir.

Typical conditions of operation follow:

Producing well head temperature	75° F.
Producing well head pressure	1100 psi.
Bottom-hole temperature	145-160° F.
Bottom-hole pressure	2100-2400 psi.

The well effluents consist of approximately 93½ percent carbon dioxide by weight, the balance being hydrocarbons with a small amount of water. No hydrogen sulfide is present. The water has an analysis typical of true condensate waters, in that only very low concentrations of salts are present.

SEVERE CORROSION of tubing and casing in distillate field production led to a series of operating tests in which various inhibitors were used, with and without plastic-coated tubing. Results obtained, together with illustrations showing severity of attack, are presented by the authors, in a paper read before the Corrosion Research Committee of the Natural Gasoline Association of America.

Well-head temperatures and pressures are in the range in which the effluents may be liquid or gaseous or both. At bottom-hole conditions the fluids are gaseous. Under static conditions, the fluid gradients range from about 0.35 psi per foot near the surface to about 0.24 at the bottom. The greater density at shallower depths corresponds with the lower temperature. Under flowing conditions there is only a slight expansion of the fluid as it flows from the bottom of the well to the top because the effect of the reduction in pressure is nearly compensated by effect of the decrease in temperature caused by heat loss to the formation.

Severe corrosion has occurred in both tubing and casing of producing wells. Considerable corrosion was also noticed in the cycling plant, while very little corrosion apparently occurs in the injection lines and wells.

A program of study and experimentation in methods of corrosion control was begun in 1946, and has continued to a successful conclusion. Methods employed in determining the extent of corrosion including tubing caliper surveys, temperature and pressure surveys, the regular use of corrosion test coupons, and the analyses for iron of water samples taken at various locations throughout the system. Corrosion inhibitors tested included manganese naphthenate, ammonium hydroxide, one proprietary compound, and two proprietary

liquids, designated A and B. Strings of plastic coated tubing were tested in two wells.

Severity of Corrosion

Evidence of severe corrosion was first noticed in March, 1946, after the field has been producing continuously for two years. The first indication was in the form of gas leaking through the ground around two of the wells. Both wells had to be killed for casing repairs. Figure 1 shows carbon dioxide blowing from a fissure 75 feet from one of the wells. What appears to be ordinary snow is actually a mixture of congealed distillate and dry ice.

Examples of tubing corrosion are shown in Figures 2, 3, and 4. A section of a corroded valve is shown in Figure 5. Prior to the establishment of a satisfactory program of corrosion mitigation, the average life of tubing in a producing well was 15 months, including considerable shutin time and time during which the wells were

FIGURE 2.

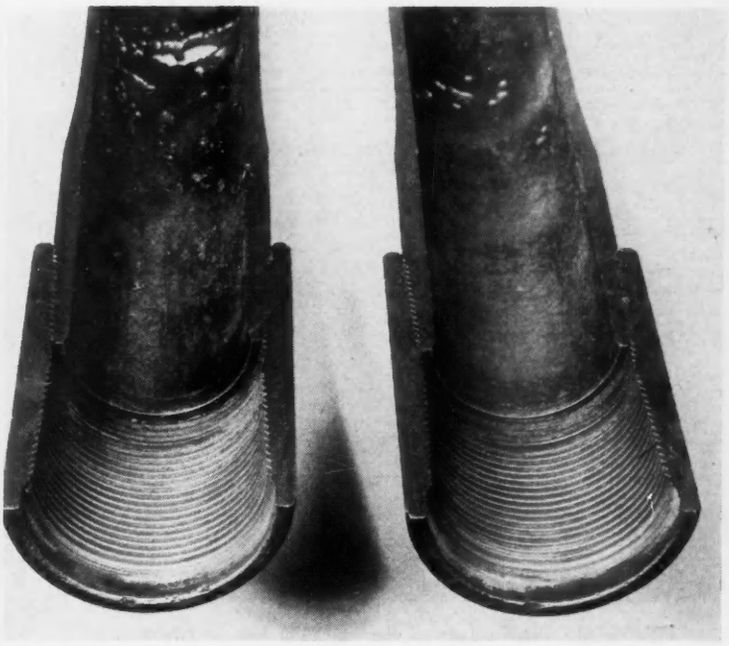


FIGURE 3.

FIGURE 4.

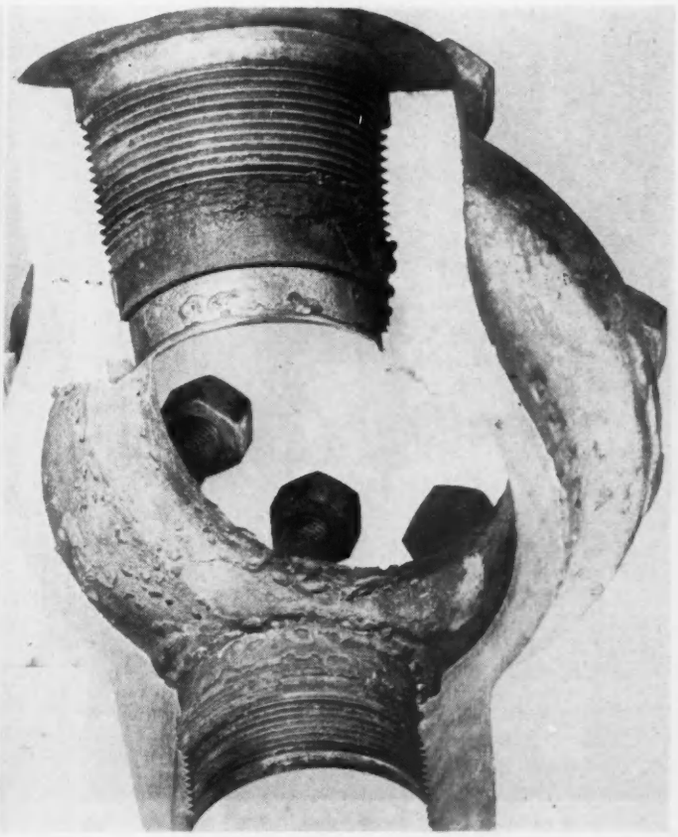


FIGURE 5.

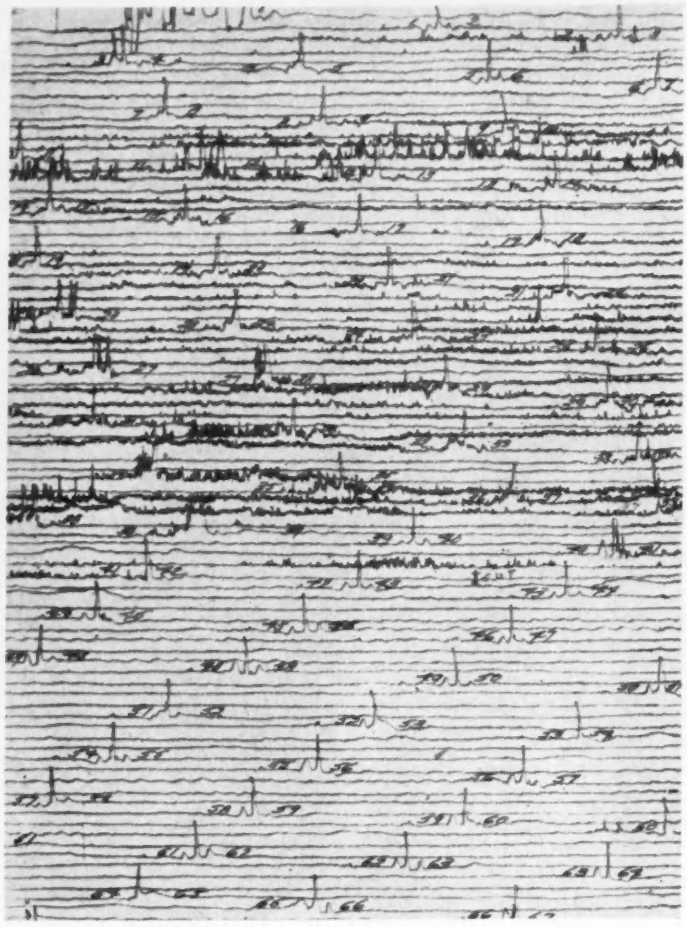


FIGURE 6. Caliper survey of the top 2600 feet of tubing.

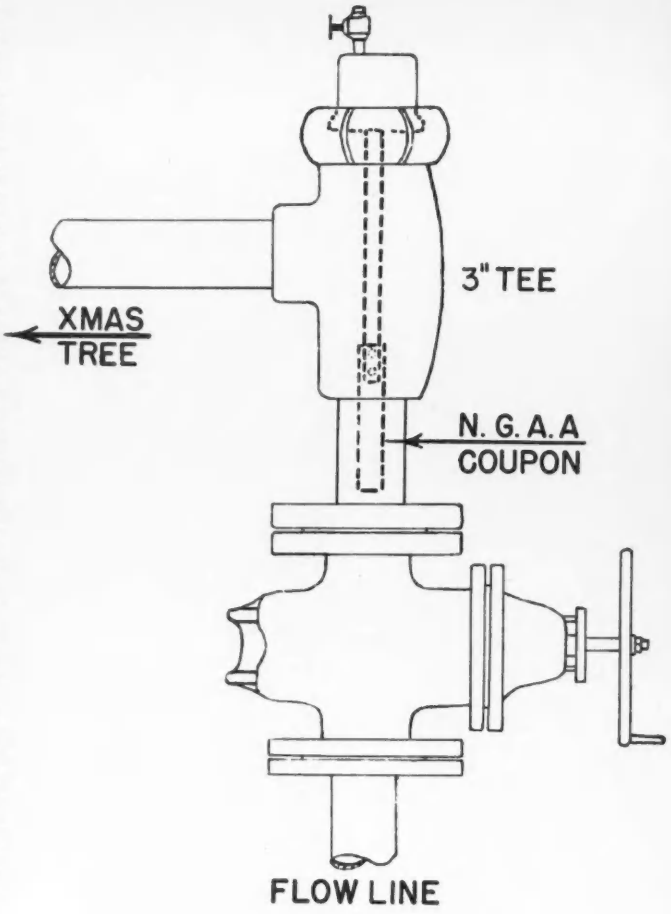


FIGURE 7. Coupon holder.

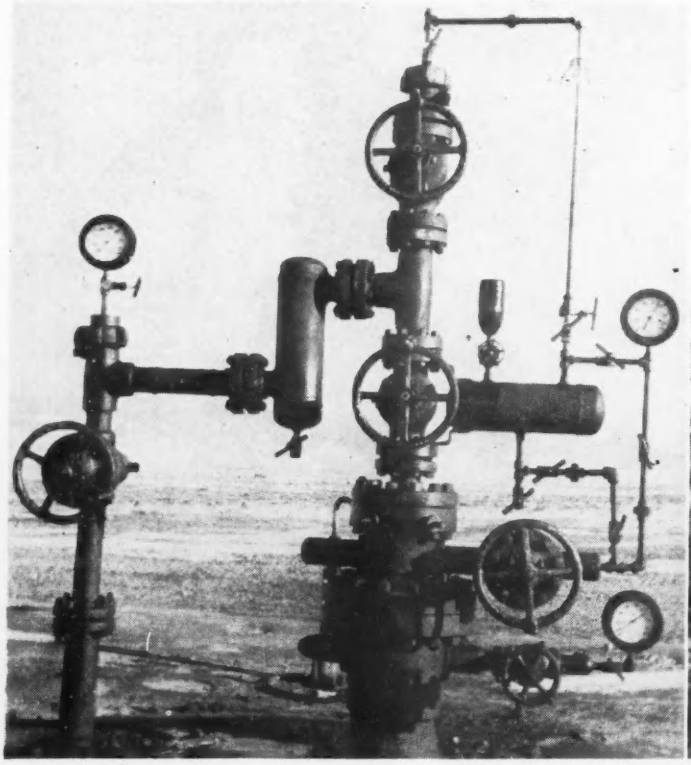


FIGURE 8. Wellhead fittings showing water drip pot on left and inhibitor lubricator on right.

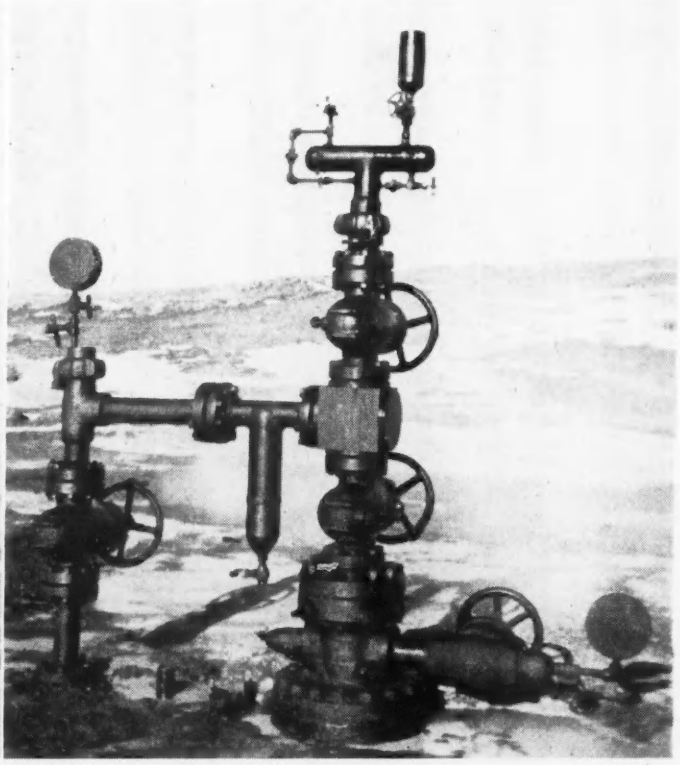
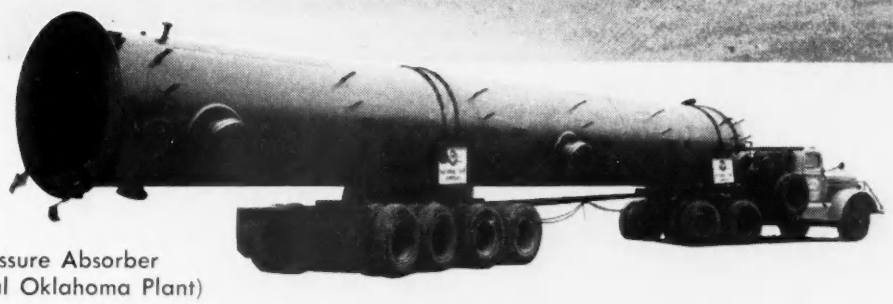


FIGURE 9. Horizontal lubricator mounted at top of tree for protection of wellhead fittings. Water drip pot on left.

De-Isobutanizer Tower 118' long
(For Texas Installation)



High Pressure Absorber
(for a Central Oklahoma Plant)

National

HAS THE "KNOW-HOW" TO PRODUCE IT!

Today, with greatly increased modern facilities, National will serve the oil industry in a much broader way. National manufactures much larger vessels with higher working pressures for gasoline extraction, refining, gas processing, chemical processing, and many other lines. With 25 years' experience, National has conceived, designed and produced many "Firsts" for the oil industry. We are constantly finding better methods of serving you with the latest and best equipment. Our well-trained staff of engineers and skilled crews work constantly with this goal in mind. "It's a National" means the finest.

It's a National

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

produced even though the tubing was known to be perforated. In two instances, tubing was perforated by corrosion approximately two months after it was run in the well.

Figure 6 records a caliper survey of the top 2600 feet of tubing in the Pollock B-1 well. This survey was made after the tubing had been in the well 386 days. No inhibitor had been used. With one exception, severe corrosion occurred only above the 38th joint. The string consisted of new eight-round thread tubing above this joint, while that below was ten V-thread second-hand tubing. There was no difference in the chemical composition of the two types of tubing. Most of the more severe corrosion has taken place at depths shallower than 3000 feet, although there have been several cases of severe corrosion occurring below 5000 feet, near the total depths of the wells.

Well casing has also undergone severe corrosion. In four wells, six casing failures developed in 2½ years. This corrosion took place during a time when wells were produced through both tubing and casing, a practice which has been discontinued. There seems to be no corrosion without fluid movement. The discovery well in the North McCallum field was drilled in 1926 and no appreciable corrosion occurred during the 20 years it was shut in.

There is evidence that corrosion occurs in the plant, but to a lesser extent than in the wells. Pits have been found in compressor valves, in cast steel valves, and in one orifice fitting. There has also been corrosion in heat exchangers and severe corrosion in the variable chokes on the incoming flow lines.

Testing Procedures

A program of inhibitor testing was started in February, 1947. The results obtained were judged by the effects of the inhibitors on the rate of corrosion of test coupons, on the iron contents of water samples, and by tubing caliper surveys.

Test coupons were not used during the early inhibitor tests. Later, however, coupon holders were installed near the well-head of each well where the Christmas tree wing turns down into the flow line. In these holders, the 8 x 1 x 1/16-inch coupons were suspended by stainless steel rods. The location of the coupon and its holder in the flow stream is illustrated in Figure 7. Coupons were exposed for a period of two weeks, which permitted weight losses up to 35 percent when no inhibitor was being used. The coupons were not re-used, but were discarded after evaluation.

Drip pots for collecting water samples were first installed at the plant, then on the christmas trees of producing wells. The pots at the plant were connected ahead of the adjustable chokes in the flow lines from each of the wells.

The first drip pot used at a well is the offset fitting shown in Figure 8. It was constructed with an inner water collecting trap and an outer annulus through which the flow stream was directed to prevent the water from freezing in Walden's frigid climate. The horizontal lubricator shown on the right in this figure is used to inject liquid inhibitor into the casing annulus. The equalizer connections between tubing and casing were used to purge the casing of a liquid accumulation which one time impeded circulation of the inhibitor. The coupon holder is shown at the head of the flow line riser on the left side of the picture.

Figure 9 shows a well at which liquid inhibitor is injected for protection of the well-head fittings and flow line. This well is equipped with plastic coated tubing. The inhibitor is injected by means of the horizontal lubricator mounted on top of the christmas tree. The short riser which supports this lubricator has no internal connection with it. The equalizer connections are on the left, and the inhibitor feeds into the well head through the one-half-inch connections at the right. The water trap is flanged to the tee above the master gate. This type of drip pot for water samples was used after it was found that the accumulated water would not freeze in the coldest weather.

Figure 10 is a picture of a well equipped with a lubricator used for injecting stick type inhibitors. This lubricator is made of two-inch pipe which extends through the three-inch coupling nearly to the wedge of the gate valve to keep the sticks centered over the tubing so they will fall when the gate valve is opened. Without this guide, it was found that the inhibitor sticks would follow the valve wedge to one side at the valve was opened and lodge in the valve.

Figure 11 shows the lubricator by means of which liquid inhibitor is injected into the gas leaving the high pressure separator. Inhibitor was injected at this point in the flow system for protection of the plant.

The water samples were analyzed for iron by titrating with potassium dichromate, using diphenylamine indicator.

The results obtained with the different inhibitors will be discussed in order of their testing.

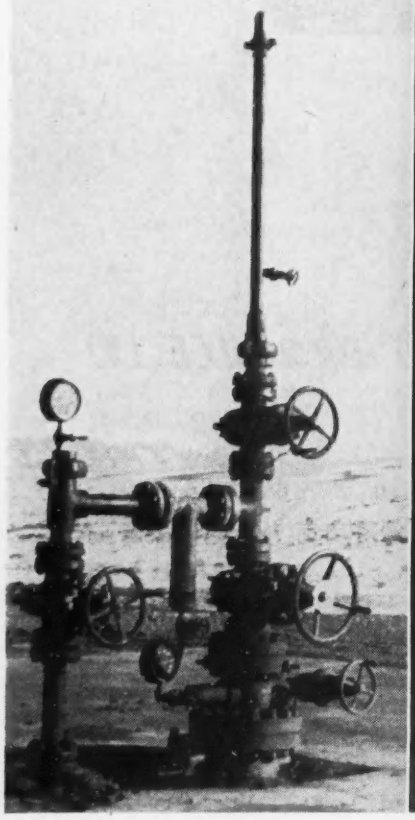


FIGURE 10. Vertical lubricator on top of fittings for injection of stick-type inhibitors.

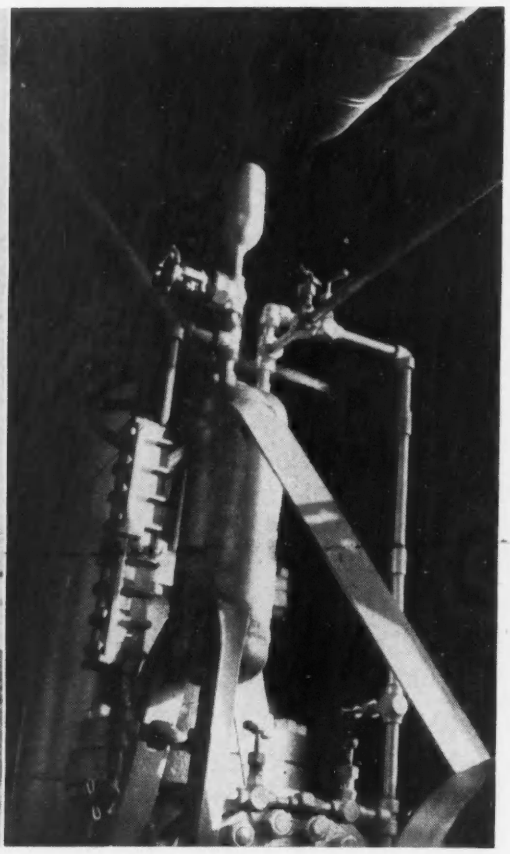
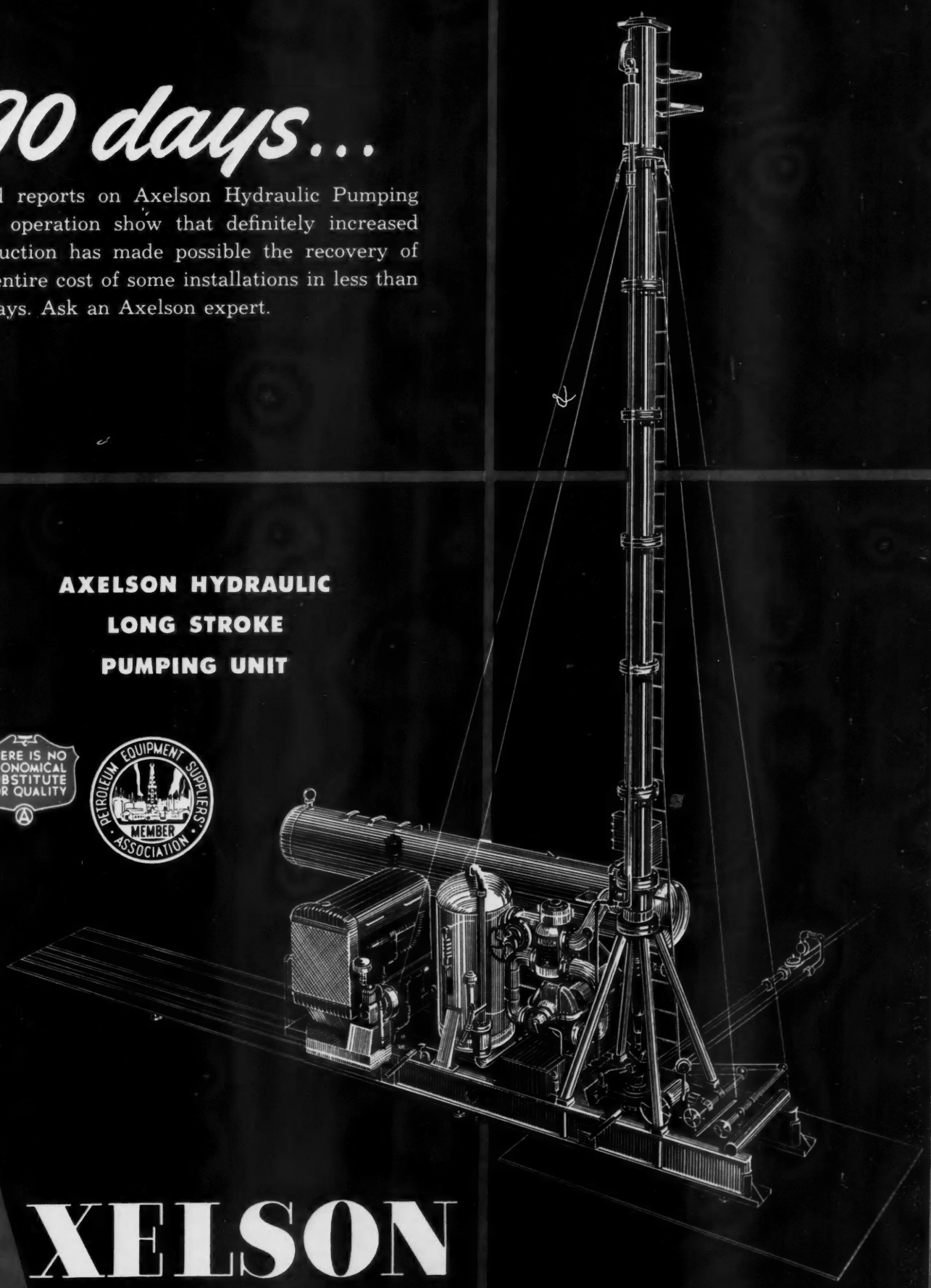


FIGURE 11. Housed lubricator for injection of liquid inhibitor into gas leaving the high-pressure separator.

90 days...

Field reports on Axelson Hydraulic Pumping Unit operation show that definitely increased production has made possible the recovery of the entire cost of some installations in less than 90 days. Ask an Axelson expert.

AXELSON HYDRAULIC
LONG STROKE
PUMPING UNIT



THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

AXELSON

First Choice

AXELSON MANUFACTURING CO. • PLANTS—Los Angeles 58; St. Louis 16 • OFFICES—New York City 7; Tulsa 1; Buenos Aires, Argentina; Caracas, Venezuela • DISTRIBUTORS—Jones & Laughlin Supply Co.; Great Northern Tool & Supply Co.; Industrial Agencies, Ltd., San Fernando, Trinidad, B.W.I.; Industrias Waldrip & Campbell, Barcelona & Maracaibo, Venezuela; Dominion Oil Field Supply Co., Ltd., Calgary, Canada; South American Supply Co., Avenida Tacna 592, Lima, Peru.

Hydrafrac and Acidizing For Processing Limestones

By C. E. CLASON

Chemical Services Coordinator
Halliburton Oil Well Cementing Company, Duncan, Okla.

HYDRAULIC fracturing by the Hydrafrac process has definitely established the successful increase of production in hundreds of wells. While this method has been applicable to limestone wells, most of the work has been in sandstone because of the former lack of any chemical or similar procedures for dissolving this type of formations. Habit and the difficulty of a coordinated process contributed to the continued use of acid alone for limestone formations. Now, by combining the Hydrafrac process and the acidizing process, calcareous or limestone formations can also be successfully treated.

Acid has practically the same viscosity as water. Many wells with only a show of oil will still have permeability enough to allow acid entrance at a slow rate of pumping. Under these conditions it sometimes requires several acid jobs or stage treatments to enlarge flow channels to the point where a commercial well is obtained. This can be true even if a pressure is reached that exceeds the overburden weight.

A highly viscous fluid such as now used in hydraulic fracturing requires smaller volumes and will produce a greater fracture under similar pressures than a thin acid solution. It is very evident that more can be accomplished with fewer trips to the well and less shutdown time, all at less expense than with old or separate methods.

Many so-called tight wells have been lightly shot previous to acidizing. The intent was to establish small crevices for acid penetration outward into the formation. This same effect can now be obtained by a combination of hydraulic fracturing plus acid injection in one operation.

Volumes used can vary, as for instance in wells close to a water drive, neither gel nor acid need to be used in amounts that might increase water encroachment.

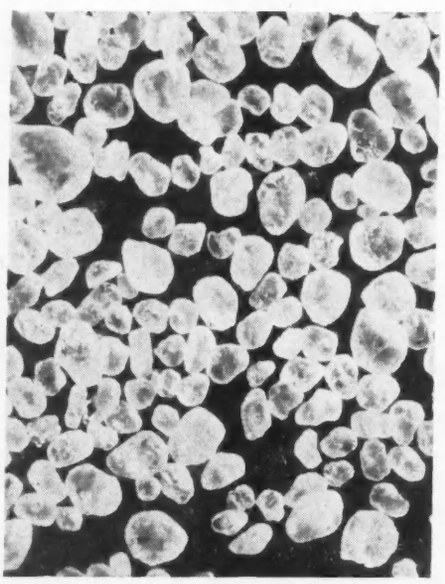
In applying this process the usual well preparation is made, Hydrafrac gel is mixed in the same manner, pumped into the tubing, followed immediately by the acid, in equal or slightly greater volume than the gel.

With fast pumping and pressure, fracturing occurs and the succeeding acid not only aids in breaking down the high viscosity of the gel where contacted but of course, spends or reacts with the formation as usual. The tubing is flushed with oil to displace the acid.

After 24 hours, the well may be put on production, although swabbing prior to pumping is beneficial.

More acid can be used, following a fracture, if desired, either on the same job or later on. It is possible for the thinner acid to travel not only out along the fracture but also out into permeable sections that would not allow entrance of the more viscous gel.

Hydrafrac gel is adaptable for temporarily plugging highly permeable sections of a well bore such as may be present in wells previously acidized.



Magnification of special sand used as a propping agent.

Other materials used in the past were never of such high viscosity at the time of entrance into the formation and often caused loss of production by their inability to flow back, thus tending to make a permanent plug.

This procedure is for the purpose of deflecting the following acid into the places in the well bore that did not receive it to any appreciable extent during a previous treatment. In this case, a pressure approaching that of the overburden is not apt to occur when the gel is being placed nor yet with the following acid. The gel thins up as usual permitting all sections to produce.

In this type of treatment, larger quantities of both gel and acid are usually needed.

The combination of these two methods for increasing production presents no different emulsion problems when the previous testings of oil samples are made in the same manner as in ordinary acidizing. There are no products of reaction that leave highly viscous materials that must be blown out by formation pressure or if not removed, that remain to cut down the well production.

The same factors and use of packers, etc., enter in selecting a well for treatment with the combination as with ordinary acidizing or the Hydrafrac process. There are no restrictions or complicated controls necessary because of varying bottom-hole temperatures, limestone content or solubility of the formation. For fracturing purposes, the same propping agent is used to prevent closure of the fracture upon release of pressure and before the acid can fully react. In fact, any well that will fill with oil can be considered as one that will fracture with the more viscous gel and thus require sand.

EDITOR'S NOTE: "Hydrafrac" is a service term originated by and the property of Stanolind Oil & Gas Company, which developed the process it describes.

Hydrafrac—Reg. U. S. Patent Office.

Wettability

In Oil Recovery

By P. T. KINNEY and R. F. NIELSEN
Division of Petroleum and Natural Gas
The Pennsylvania State College, State College, Penn.

THE RELATIVE wetting power of oil and water for a porous medium affecting such things as saturation distribution in a reservoir and relative mobilities of the fluids are discussed. Examples of oil wet and water wet sands and their behavior during laboratory tests are cited. Measurements of capillary pressure and flooding behavior of cores before and after being made artificially oil wet are reported, and the results analyzed in the light of theories. This is from a paper presented at the Thirteenth Annual Conference on Secondary Recovery at the School of Mineral Industries of The Pennsylvania State College, State College, Penn.

WHEN two or three fluid phases, such as oil and water or oil, gas, and water, are present in the interstices of a porous solid, the distribution or location of the phases with respect to each other in the pores of the solid is largely governed by what is known as the wettability of the solid by the liquids. The factor of wettability enters into reservoir performance in both primary and secondary recovery, and into such laboratory measurements as capillary pressure and relative permeabilities.

The problem of relative wettability of solids by liquids or, conversely, the relative wetting power of different liquids for certain solids, has been studied by chemists and physicists for a long time. A number of fundamental mathematical relations have been worked out. These may be found in standard texts on the subject and have also appeared in recent papers dealing with the role of wettability in oil production.

It is known that many common liquids will wet a clean, dry glass surface. If such liquids as water, alcohol, or any common oil are put into a beaker and poured out again, a layer or film of the liquid remains on the glass. Clean mercury, on the other hand, does not remain on a clean glass surface. The relative wetting power of water and mercury toward glass is better shown by their behavior in glass capillaries, as illustrated in Figure 1. Water rises in a capillary while mercury is depressed. This is associated with the nature of the meniscus, or air-liquid interface, the liquid surface being concave in the case of the water and convex in the case of the mercury. The angle Θ that the interface makes with the glass at the solid surface (measured in the liquid phase) is called the contact angle, the magnitude of which is the basis for the measurement of relative wetting powers.

If the liquid-solid contact angle is zero or 180 degrees for two liquids to the same solid surface, its magnitude cannot be used to determine the relative wetting ability of either phase. Oil and water, for instance, both rise in glass capillaries, usually with zero contact angle. In that case, the relative wetting power must be determined with an oil-water interface as shown in Figure 2. A concave liquid surface is created in the phase that preferentially wets the glass, in the first case (a) the water phase, in the second example (b) the oil phase. Here again the contact angle measures the relative wetting power of oil and water. The smaller the contact angle, measured through the wetting phase, the greater is the wetting power of that phase.

Wettability measurements are usually complicated by the fact that they are dependent on the previous treatment of the solid. If, for instance, a clean glass capillary is wetted completely with water before an oil-water interface is introduced, a water film will usually remain between the water and the glass. In this case the apparent contact angle is zero in the water phase and no quantitative comparison can be made between the two liquids in regard to their relative wetting power toward the solid. If the glass is first completely wet by the oil, the water may completely displace the oil on the glass surface as the interface is introduced, and in that case an equilibrium contact angle is set up. As will be shown subsequently, in the case of natural cores much depends on which phase was there first, and on the previous treatment of the dry solid.

The manner in which wettability determines the location of the fluids in a porous medium may be shown from the case of packed spheres by Figure 3. If the water preferentially wets the solid, the contact angle is less than 90 degrees in the water phase. In the illustration it is zero. With a zero contact angle in the water phase, the interfacial tension pulls the water phase into the interstitial angles, leaving the oil phase in the open pore spaces. It is apparent from Figure 3 that wettability is a factor in determining the relative mobilities of oil and water. For instance, in the case of packed spheres, as shown in this figure, a certain amount of water could be held in the interstitial angles without interfering appreciably with the flow of oil. This accounts partially for the difference in the relative permeability-saturation relations for the wetting phase as compared with those for the nonwetting phase. This has been discussed by Rose[1] and others.

Since the wetting characteristics of a sand or other porous body affect the relative mobilities of the fluids within the body, it would be expected that the behavior of an oil-bearing sand during a water flood would de-

pend on whether the sand was preferentially oil wet or preferentially water wet. It was, in fact, the peculiar flooding behavior of certain sands that led to some experimental work on relative wettabilities in this laboratory about three years ago. It had been noted that in water-flooding some long cores of the Chipmunk sand, previously saturated with oil, a large part of the oil was produced after water broke through at the producing end. This behavior was contrary to that of Venango and Cow Run sands, and was attributed to possible preferential wetting of the sand by oil. Consequently it was decided to study the flooding characteristics of several cores before and after a treatment which would render the internal surface oil wet.[2] The series of experiments was completed only on a synthetic porcelain core. This core was two inches in diameter and ten inches long, and was mounted in Lucite in the usual manner. The untreated core, which was preferentially water wet, was first saturated with oil and water driven. Then it was cleaned, saturated with water and oil driven. It was found that in the first case 83 percent of the recoverable oil was produced before water breakthrough, and in the second case only 42 percent of the recoverable water was produced before oil breakthrough. The core was then given a treatment which would render the surface preferentially oil wet. After the treatment the behavior was largely reversed. When oil was displaced by water, only 77 percent of the recoverable oil was produced before water breakthrough; but, when water was displaced by oil, 91 percent of the recoverable water was produced before breakthrough. These results lent further credence to the theory that the Chipmunk core was preferentially oil wet since its behavior was similar to that of the treated porcelain core. In order that the results from the porcelain core may be observed to advantage they are tabulated in Table 1.

TABLE 1

Type of Flood	Percent Total Recovery	Percent Recovery at Breakthrough	Percent of Total Recoverable at Breakthrough	Condition of Core
Oil by H_2O	72.0	59.4	82.5	Untreated
H_2O by Oil	68.5	28.5	41.7	Untreated
Oil by H_2O	51.3	39.2	76.5	After treatment
H_2O by Oil	79.8	72.4	91.0	After treatment

The effect of liquid mobilities on the production of oil before and after breakthrough of water in a water flood has been discussed by a number of authors[3] and also demonstrated.[4] It would be expected that the lower the ratio of the viscosity of the driving medium to that of the driven medium, the earlier in the history of a drive would the driving medium break through to the producing end. The relative permeability-saturation relations normally are such as to favor the movement of a non-wetting driving medium over a wetting driving medium. Thus, if the water and oil have equal viscosities the oil recovery at water breakthrough during a water flood is more nearly complete if the sand is water wet than if it is oil wet. This may be illustrated by a pair of relative permeability curves for a Venango core shown in Figure 4. Letting subscripts n and w denote non-wetting and wetting phases, respectively, k_n at the saturation where k_w is some low value, say 0.01, is higher than is the value of k_w at the saturation where k_n is 0.01. It is the relative permeability ratio in the saturation range corresponding to low permeabilities of the driven medium that is critical in determining the saturations at breakthrough of the driving medium. Attempts have been made to calculate liquid saturations at breakthrough from viscosity and relative permeability relations[5] and such calculations are at least in qualitative agreement with experimental observations.

Laboratory studies on wettabilities in natural sands were recently resumed. Because of the peculiarities previously found in samples of the Chipmunk sand, the study was begun with two cylindrical cores of this sand, measuring 40 and 20 centimeters in length and having the same diameter of 5.5 centimeters. These were mounted in Lucite with pressure and conductivity taps in the manner described in other papers from this laboratory. As soon as water was introduced the permeabilities decreased to a very low value, so that to date it has not been possible to obtain the desired data on these cores. It is intended to continue the work with them.

A Venango core taken from the Franklin mine was selected for study. This was mounted in Lucite in the same manner as were the Chipmunk cores. The length of this core was 38 cm., the diameter 5.35 cm., the average permeability during the tests 69.1 millidarcys, and the porosity 11.33 percent. The plan was to conduct flooding tests on this core, then give it a chemical treatment to make it preferentially wet by oil and repeat the flooding tests.

The core was first saturated with a 0.25 normal sodium chloride solution and its permeability determined. It was then flooded with oil until no more water was produced, and the permeability to oil determined. Finally, a water flood (0.25 normal sodium chloride) was imposed until no more oil was produced. During these runs, pertinent data such as productions of oil and water, and pressure drops over various sections of the core were obtained. Three floods of this type were run before treatment—one using a

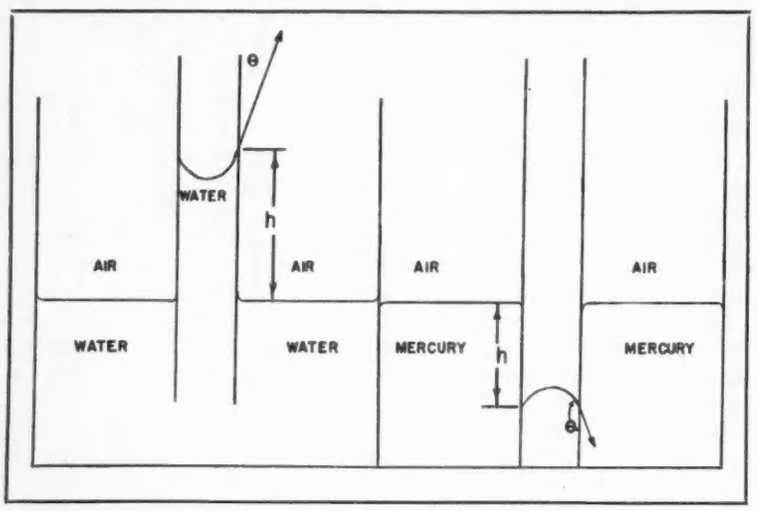


FIGURE 1. Wetting and non-wetting liquids in capillary tubes.

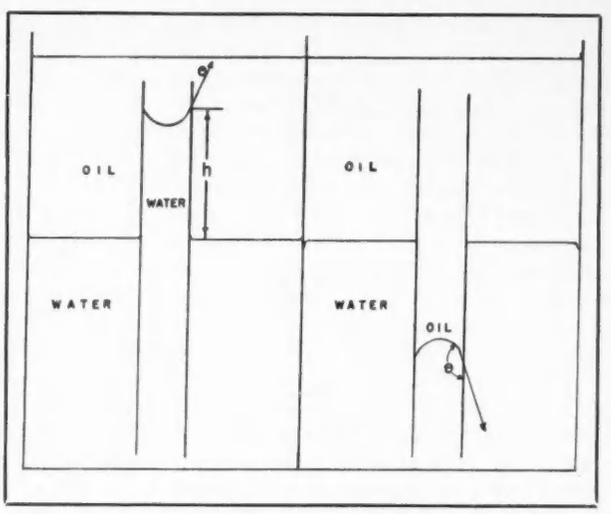


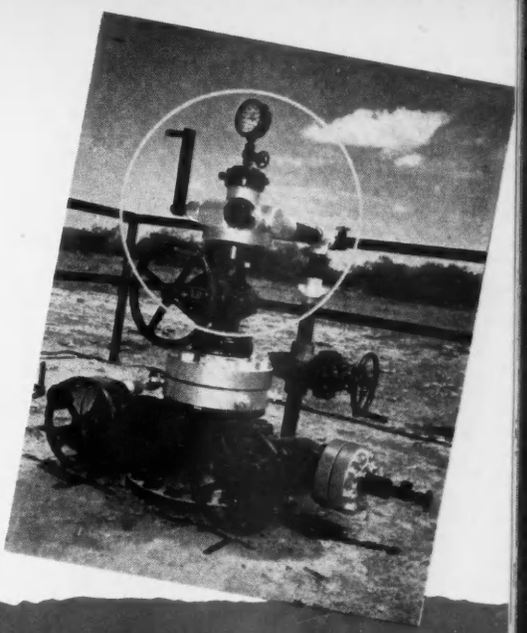
FIGURE 2. Preferential wetting of a solid by water (left) and oil (right).

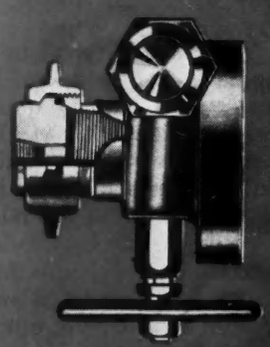
Compact, easy-to-operate

O-C-T "JE" FLOW CONTROLS

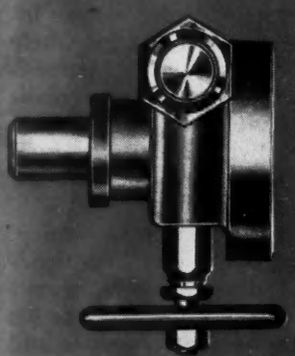
reduce weight, reduce cost

as much as 90%



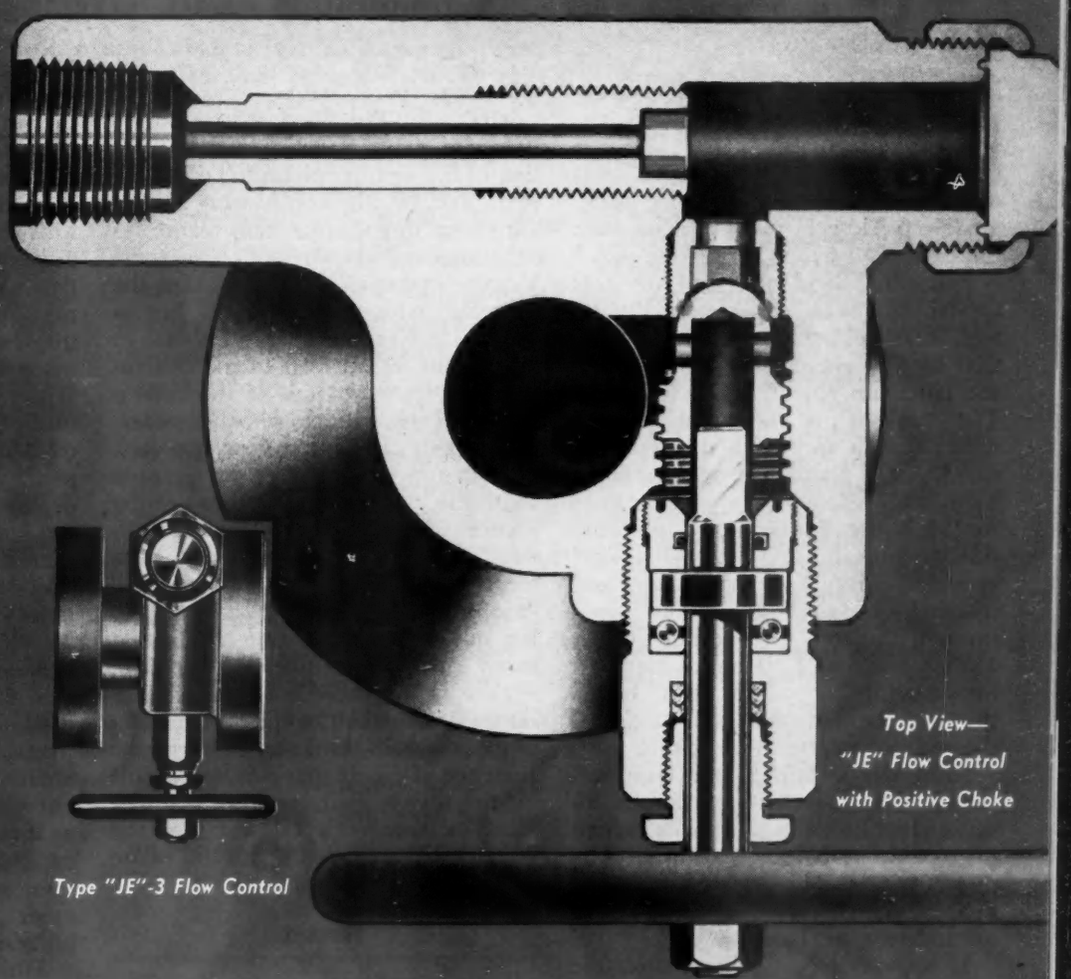


Type "JE"-1 Flow Control



Type "JE"-2 Flow Control

Type "JE"-3 Flow Control



Top View—
"JE" Flow Control
with Positive Choke

This compact, easy operating O-C-T "JE" Flow Control Unit . . . adaptable to either positive or adjustable chokes . . . performs the functions and takes the place of a Christmas Tree cross or tee, wing valve, adjustable or positive choke and the upper bottom hole pressure connection adapter. It eliminates the flange connections between the tee and the bottom hole test adapter, between the tee and the wing valve and between the wing valve and the choke. Thus, O-C-T "JE" Flow Control Units effect a cost saving ranging as high as 90 per cent when used to replace 10,000 lb. test conventional wings. In addition, O-C-T "JE" Flow Control Units effect weight savings up to 70% . . . operate free and easy at high pressures . . . provide quick, easy field maintenance.

O-C-T "JE" Flow Control Units are now proved in service by more than 3000 installations. They are available through all recognized supply stores.

Oil Center Tool Co.

P. O. Box 3091, Houston, Texas

Canada — Canadian-Vickers, Montreal, Canada

Sterling Areas — Le Grand, Sutcliff & Gell, Ltd., Southall, Middlesex, England. Address Export Inquiries for All Other Countries to P. O. Box 3091 Houston 1, Texas.

O-C-T PRODUCTS — *Dependable and available through more than 700 supply store locations*

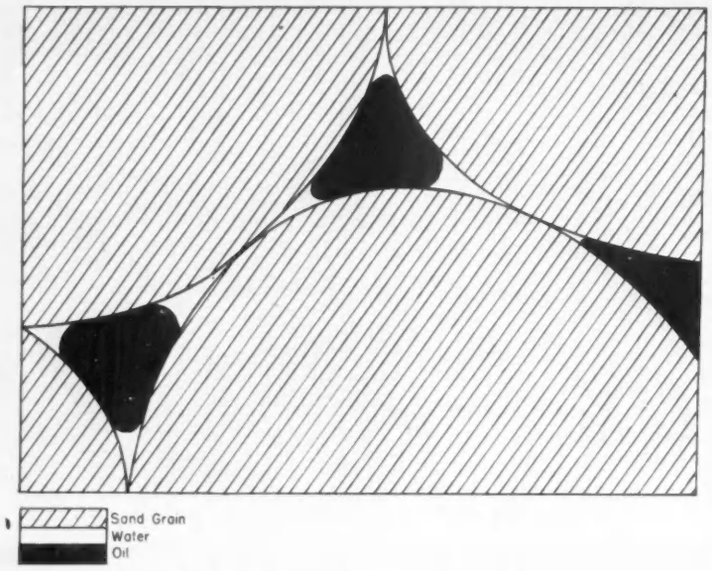


FIGURE 3. Interstitial fluid distribution.

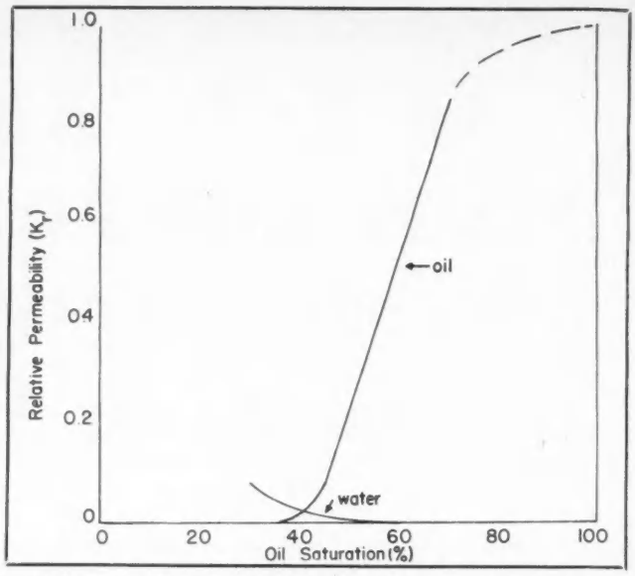


FIGURE 4. Oil-water relative permeability vs oil saturation, Venango core.

Bradford crude of 5.24 centipoise viscosity and a pressure drop of 74 cm. of mercury across the core, one using the same crude but a pressure drop of 64 cm. of mercury and one using a 6.24 cp. closecut oil with a pressure differential of 64 cm. of mercury.

Following these runs the core was treated to make it preferentially oil wet. The treatment was the same as that used by Henderson and Smith on the porcelain core referred to above. The core was first thoroughly cleaned with naphtha and distilled water, and dried. Air of about 70 percent relative humidity was passed through the core for 24 hours. Immediately following this, dry air saturated with "Dri-Film" vapor (a mixture of mono-, di-, and tri-ethyl chloro-silane) was blown through the core for one hour under a pressure drop of 50 cm. of mercury. Subsequently, dry air was blown through the core until the exit air showed no indication of acidity.

After the treatment the core was saturated with water (.25 normal sodium chloride) and the floods carried on exactly as before treatment. The results from the sets of runs made before and after the treatment may be summarized in Table 2.

It appears from Table 2 that the figures for the percentages of the recoverable driven medium produced at breakthrough were reversed by the treatment. This fact indicates that the core was originally preferentially water wet, and its wetting properties have been so changed as to make it act as an oil wet sand. It can also be seen from the table that the residual saturation of the non-wetting phase is in all cases greater than that of the wetting phase. This may fall in with the theory that the non-wetting phase is trapped by the wetting phase in certain large pores whose exits are of smaller size. The flood on the porcelain core showed the residual saturation of the wetting phase to be greater than that of the non-wetting phase. This is in direct opposition to the results obtained when flooding the Venango cores. It is thought that the porcelain core is much more homogeneous in structure than the Venango sand. This would lead to the conclusion that the structure of the core is of prime importance when considering the role of wettability on recovery.

It should not be taken for granted that the wetting and non-wetting phases were completely reversed by the "Dri-Film" treatment. Besides the terms "preferentially oil wet" and "preferentially water wet" are more or less qualitative. It is quite likely that many sands are completely water wet —that is, that there is a film of water on the sand grains so that the contact angle is zero in the water phase in the presence of oil. It may not be possible by the above treatment to make the sand so completely oil wet that the contact angle is zero in the oil phase in the presence of water.

TABLE 2

	Oil Into Water		Water Into Complex	
	Irreducible Water Saturation (Percent)	Percent of Total Recoverable at Breakthrough	Residual Oil Saturation (Percent)	Percent of Total Recoverable at Breakthrough
Run 1: (Bradford Crude)...	32.3	70.2	35.6	90.9
Run 2: (Bradford Crude)...	29.6	72.6	37.5	91.1
Run 3: (Bradford Crude)...	29.1	75.3	40.2	94.8
After Treatment: (Bradford Crude)...	42.6	90.8	37.6	70.0

The term "preferentially wet" by a certain phase may be qualitative in more than one sense. It may imply any contact angle of less than 90 degrees in the phase that preferentially wets the solid. The term may also be qualitative in the sense that the relative wetting power of the two fluids may not be the same at all points, but that on the average the solid is wet more by one fluid than by the other. If the solid is not completely wet by a film of one phase there may be both oil-solid and water-solid interfaces, depending, among other things, on the degree of curvature of the various interfaces involved. Finally, the whole thing may be complicated by hysteresis effects or lack of equilibrium conditions, especially in the case of flow of the fluids, for which such terms as "advancing and receding contact angles" have been coined.

As was mentioned at the beginning, wettability not only enters into floodability and production measurements but also into such static measurements as those of displacement pressure and capillary pressure. Measurements of these quantities were reported in another paper[6] and the effect of wettability relations were mentioned therein.

Much of the pioneer work on wettability, especially as applied to porous media, was done by Bartell and coworkers in connection with the API project at the University of Michigan.[7] The concept of displacement pressure and its relation to interfacial tension, contact angle, and pore sizes were applied in many of their measurements. According to Figure 2, a pressure would have to be applied to force oil further into the capillary if the glass is preferentially wet by the water. Similarly, if a porous plug preferentially wet by water was completely satu-

SPINDLETOP IS OUR ALMA MATER

GULFCO was 'reared' in the BEAUMONT • SPINDLETOP AREA

. . . . which was and is an area of most exacting requirements — an unexcelled proving ground for keeping Gulfco products advanced in design, proved in use,

...LEADERS THE WORLD OVER

For 32 years GULFCO has been a pioneer and a leader in making Forged Steel Well Head Equipment

This experience, together with a reputation for thoroughness and competence, ASSURES YOU TREES THAT WILL DO THE JOB AFTER THEY GO ON THE WELL . . . Trees with a large factor of safety . . . Trees made to very close tolerances, assuring you time-saving dependability on the lease.

GULFCO TYPE FO TUBING HEAD

GULFCO Type FO Tubing Heads are furnished in four principal types. Each type is assembled with one standard full opening forged steel body which is designed for 4000 PSI test pressure or 2000 PSI cold working pressure. Each type can be converted to the other by an interchange of parts regardless of casing size. These tubing heads can be furnished, male or female, in casing sizes from 5" OD to 7" OD to accommodate 2", 2½" or 3" regular or upset tubing. Two 2" API line pipe side outlets are regularly furnished. Special adapters for installation of gate valves, oil savers and other production equipment can be furnished on short notice for the type FO Tubing Heads.

PRODUCTS manufactured by GULFCO

- Xmas Trees
- Casing Heads
- Tubing Heads
- Casing Head and Tubing Head Adapters
- Stripper Rubbers
- Stripper Rubber Pullers
- Christmas Tree Fittings: Adjustable Chokes . . . Positive Chokes . . . Bull Plugs . . . Crosses . . . Tees . . . Ells
- Quick Change Crosses and Tees: Tie Rods . . . Tie Rod Clamps . . . Flanges and Flange Unions . . . Nipples
- Casing Shoes
- Slush Pump Liners
- Low-Pressure Gas Burners
- Low Water Alarms
- Emergency Fuel Shut-Offs
- Boiler Feed Water Regulators
- Gas Firing Controls

GULFCO FORGED STEEL FOR SAFETY

GULF COAST MACHINE & SUPPLY COMPANY

GULF CO TRADE MARK PRODUCTS

GENERAL OFFICE AND SHOP: 305-315 Orange Street, P. O. Box 1150 — Phone 2-8481

BEAUMONT, TEXAS

HOUSTON SALES OFFICE: Esperson Bldg., Houston 2, Texas—Phone FAirfax 1544

NEW YORK EXPORT OFFICE: R. S. Stokvis & Sons, Inc., 17 Battery Place, New York 4, N. Y.

rated with water, a pressure, known as the displacement pressure, would have to be applied to force oil into the plug and displace part of the water. Conversely, if this same plug was first saturated with oil it would be expected that if one end of the plug were immersed in water, water would be drawn in and oil thrown out at the other end. This can easily be demonstrated with natural sands that have been acid leached and fired, or with synthetic porous media. In the case of natural cores that have not been acidized or fired, the preferential wettability is not so apparent and depends more on which phase was there first as will be seen in connection with the experimental data.

The usual capillary pressure curve for a core gives the pressure drop across the interface between two fluids at various saturations with respect to the fluids. This pressure drop is dependent on the degree of curvature of the interface as well as on the interfacial tension. Since the wettability relations govern the fluid distributions and hence the shape of the interfacial surfaces, these wettability relations naturally enter into capillary pressure measurements. The pressure drop occurs in going from the non-wetting to the wetting phase. Theoretically, if it were possible to so alter a porous medium which is completely wet by water in the presence of oil that the surface would be completely wet by oil in the presence of water (zero contact angle in both cases) the capillary pressure-saturation curve would not be altered, the only difference being in the fluid that must be displaced during measurement. However, the relative wetting of the solid by oil and water in the presence of each other may be complicated by various factors.

The role of wettability became quite apparent in the determination of capillary pressure curves for cores of the Bradford and Berea sands.[6] The technique used was to saturate the extracted and dried cores with water or brine and then to displace this with oil, employing a diaphragm which would allow only the aqueous phase to leave the core. If the sands were preferentially water wet a pressure would have to be applied to displace the water by oil, the pressure which would just start the displacement being the "displacement pressure." It was found that not only was the displacement pressure very small considering the permeability, but also that a large percentage of the water was removed by a low pressure (Figures 5 and 6). This would indicate that the preferential wetting by water was very slight over that by oil even though the water was there first. "Brine into oil" capillary pressure measurements have not been made on these cores, but from previous experiments with flooding tests, a slight pressure is also required as a rule to displace oil with water if the oil is there first. These results indicate that the preference, if any, of the Bradford samples for water over oil is very slight as compared to Venango samples. What part the extraction has played in determining the wettability is not known. However, the Venango cores were extracted in the same way as the Bradford cores.

Air as Medium

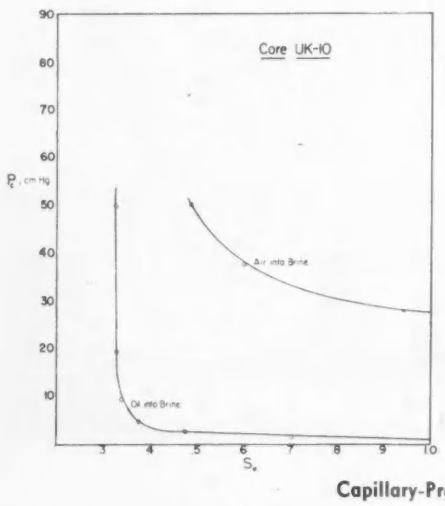
To show that the low displacement pressures were associated with wetting and were not due to capillary size distribution, repeat runs were made using air as the driving medium. The results are shown in Figures 5 and 6. It is seen that the displacement pressure for air is many times that for water, while the substitution of an air-water interface for an oil-water interface would account only for a factor of two. The contact angle for the air-water interface is presumably zero or nearly so, whereas that for the oil-water interface apparently is much larger. The curves for air also are not so flat in the lower portions as those for oil. It appears, therefore, that when oil and water are both present in these cores the oil has about the same tendency to wet the solid as has the water.

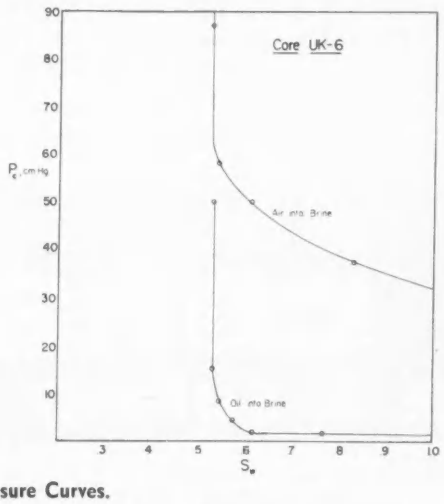
Figure 6 shows the same residual water saturation when water is displaced by air as when it is displaced by oil. This close agreement must be attributed to coincidence, although ordinarily the saturation at which the relative permeability to the preferentially wetting phase becomes zero would not be expected to depend much on the nature of the other phase.

The question naturally arises as to which fluids should be used to obtain a capillary pressure curve. This would seemingly depend on what use is to be made of the curve. If the curve is to give some kind of a picture of the pore pattern, the fluid system should be such as to leave no doubt about the relative wetting powers. For field application, however, there may be times when it may be desired to make capillary pressure measurements with the fluids that are present in the reservoir even though the differences in their wetting powers are not so pronounced.

Measurements involving the capillary pressure technique were also made on small Venango cores before and after treatment with the "Dri-Film." The capillary pressure curves obtained by displacing water with oil before the treatment are shown in Figures 7 and 8. The shape and reasonably high displacement pressure indicate that they were definitely water wet before treatment. After the "Dri-Film" treatment one core was saturated with water and attempts were made to obtain an oil into water capillary pressure curve.

It can be seen from Figure 7 that the displacement pressure after treatment was lower than that found when the core was run in its natural state (water wet), but only by a factor of about ½. It was expected that the displacement pressure would be much lower (theoretically it should be negative). This led at first to the belief that the treatment had not been complete or that the treatment could not be used to make the core preferentially oil wet. But, on analyzing the data together with the data on another core





Capillary-Pressure Curves.

FIGURE 5.

FIGURE 6.

BEFORE THEY START!

Automatic lubrication eliminates most valve failures and consequent replacement:

In christmas tree service, a valve must stay tight or it is quickly destroyed — even a small leak will cause rapid erosion and corrosion with consequent valve failure.

To prevent leaks, all McEvoy Valves have an automatic lubrication system that actually stops leaks before they start. The operation of this system is described below.

Automatic lubrication is only one of the many features that make this valve last longer without maintenance. Write us for full information.

Also Available in Stainless Steel

McEvoy COMPANY

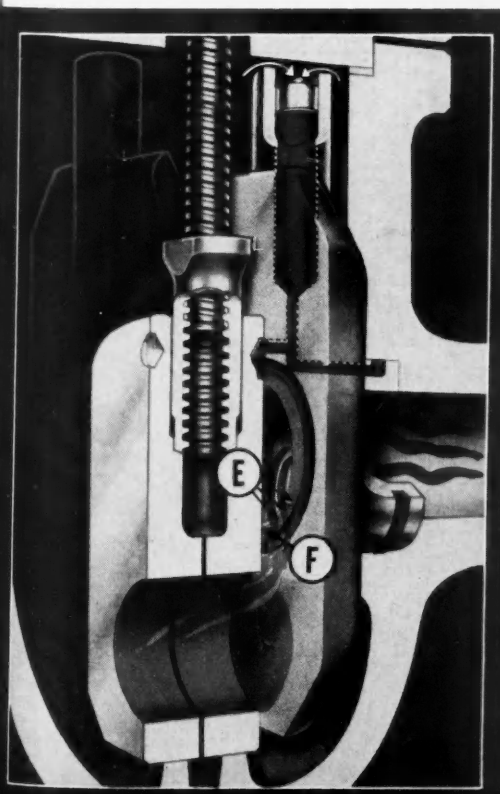
TEXAS AND MILBY ST. • P. O. BOX 3127 • HOUSTON 1, TEXAS

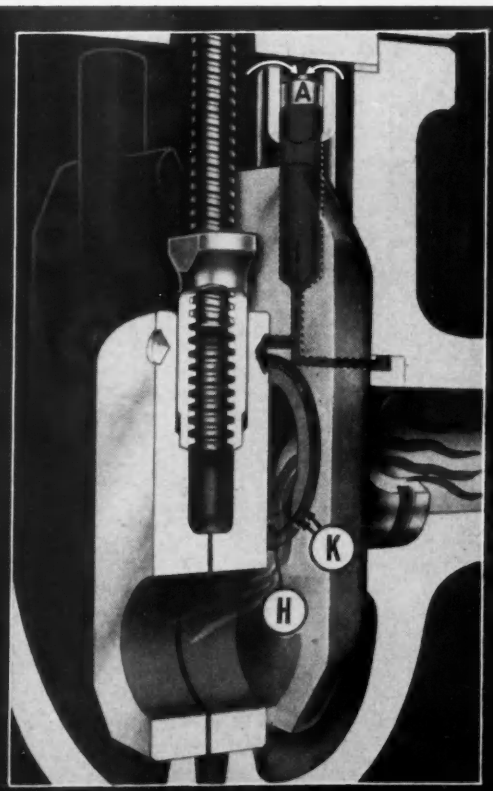
Export Representative: E. F. Gahan, Inc., Room 1223, 500 Fifth Avenue, New York, N. Y.

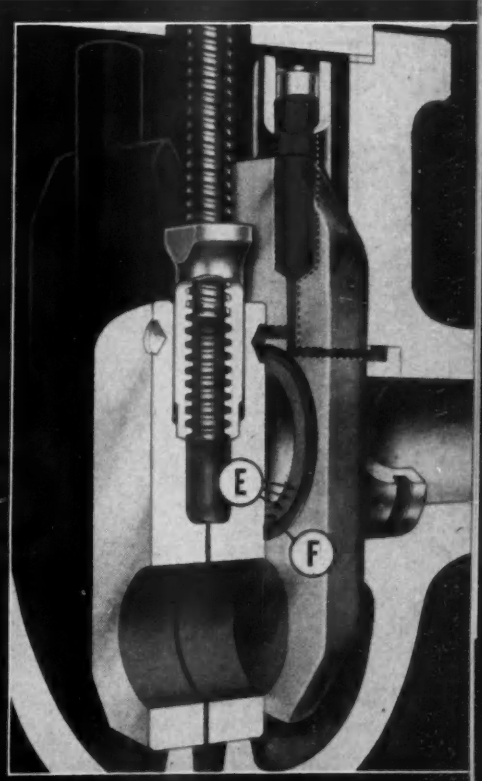
When the valve is closed the two washed surfaces E and F may not hold the line pressure and a leak starts. With manually lubricated valves the operator must insert enough grease to stop the leak or the valve will cut out.

This leakage sets up unbalanced forces. The pressure of the line fluid in the groove at H is less than the pressure of the grease in the groove at K because fluid pressure at H is bleeding off to the low pressure of the downstream conduit while the grease at K is under full line pressure as transmitted through the piston A. When this pressure differential becomes great enough, grease will be forced to fill the groove from K to H.

This condition causes the lubricant to move into the area between the sealing surfaces E and F until the leak is packed off. When the leak is stopped pressures are again balanced and no lubricant is used until it is needed again. *As long as there is lubricant in the reservoir there is no chance for a McEvoy Valve to cut out.*







treated at the same time and in the same manner, a different conclusion was reached.

The other core, after the "Dri-Film" treatment, was saturated with oil and a water into oil capillary pressure curve obtained. This curve is shown in Figure 8 together with the curve obtained before treatment. It should be noted that the displacement pressure of water into oil after treatment is higher than the oil into water displacement pressure before the treatment. It appears, therefore, that the affinity of the sand for oil is greater after the treatment than the affinity for water before the treatment. The internal surfaces of the two cores after treatment were very likely similar before any liquid entered, that is, having a higher affinity for oil than for water. The preceding analysis of the curves shown in Figure 8 led to a somewhat different interpretation of Figure 7 than was at first made. It seems to be generally true, as was pointed out earlier, that the wetting behavior of a natural core depends a great deal on which liquid entered the dry core first.

In the case of the Bradford sand curves Figures 5 and 6, the same interpretation as was made for Figure 7 may be valid, that is, the affinity of the dry core for oil was actually greater than the affinity for water. In fact, it has often been suggested that the flooding behavior of the Bradford sand is associated with the tendency to be oil wet. This might be illustrated with a typical pair of relative permeability curves for this sand, shown in Figure 9.[8] The high value of the relative permeability to water at the residual oil saturation indicates preferential wetting by the oil. This high permeability to the water is in one sense desirable in water flooding. The fact that it favors the production of some oil after breakthrough may not be serious in the field, where time must be allowed in any case for production from layers of varying permeabilities. Thus, the relation of production behavior to wettability in secondary recovery operations demonstrates the need for pertinent information and understanding regarding this factor.

Summary

- The general relations of wettabilities to fluid behavior in capillaries and porous media were discussed.
- The relation of wettability to fluid mobility was pointed out and demonstrated by the flooding behavior of a synthetic and a natural core before and after a treatment that would render the internal surfaces oil wet.
- It was found that the percentage of recoverable oil produced before water breakthrough was greater in a preferentially water wet porous medium than in a preferentially oil wet porous medium. Analogous results were obtained when water was driven by oil.
- The residual wetting phase saturation was higher than the residual non-wetting phase saturation in the synthetic core, both before and after treatment. The residual non-wetting phase saturation was higher in the case of the natural core.
- The results of Paragraph 3 are in line with the common observation that the non-wetting phase permeability at residual wetting phase saturation is higher than the wetting phase permeability at residual non-wetting phase saturation.
- Comparison of oil-brine and air-brine capillary pressure curves for two Bradford cores indicated a tendency for these cores to be preferentially oil wet, or at least not definitely water wet.
- Capillary pressure curves for two Venango cores before and after treatment to render them "oil wet" demonstrated that wettabilities were affected by the order in which two liquids were allowed to enter the solid.

ACKNOWLEDGMENTS

The writers of this paper wish to thank the members of the staff of the Division of Petroleum and Natural Gas, in particular James Henderson and C. Drew Stahl, for their assistance and advice. They also wish to thank the Pennsylvania Crude Oil Association for its support of a part of this work.

BIBLIOGRAPHY

[1] W. D. Rose, "Theoretical Generalizations Leading to the Evaluation of Relative Permeability," *Pet. Tech.*, Vol. 1, No. 5, May 1949.

[2] J. H. Henderson and K. W. Smith Progress Reports, Experiment Station J-2, Penn. State College, #121-127, March-Sept., 1947.

[3] S. E. Buckley and M. C. Leverett, "Mechanism of Fluid Displacement in Sands," A.I.M.E. *Pet. Devel. and Tech.*, Vol. 146, p. 107 (1942).

[4] (a) K. D. Sheppard, "A Study of the Effects of Pressure Gradients on Water Flooding," M. S. Thesis, Penn. State College, 1949. (b) M. Felsenthal, "A Study of the Effect of Viscosity on Oil Recovery by Water Flooding," M. S. Thesis, Penn. State College, 1949.

[5] E. D. Babson, "Prediction of Reservoir Behavior from Laboratory Data," *Pet. Devel. and Tech.*, p. 120 (1944).

[6] C. D. Stahl and R. F. Nielsen, "Residual Water and Residual Oil Saturation on Capillary Pressure Technique," *Producers Monthly*, Vol. 14, No. 3, Jan. 1950. Also: WORLD OIL, Vol. 131, No. 3, (Aug. 1950, p. 160).

[7] (a) F. E. Bartell and F. L. Miller, "Degree of Wetting of Silica by Crude Petroleum Oils," *Ind. Eng. Chem.* 20, p. 738 (1928). (b) F. C. Benner, C. G. Dodd, and F. E. Bartell, "Evaluation of Effective Displacement Pressures for Petroleum-Oil-Water-Silica Systems," *Drilling* and *Production Practice*, p. 169 (1942). (c) Frank C. Benner, Wesley Riches, and F. E. Bartell, "Nature and Importance of Surface Forces in Production of Petroleum," *Drilling* and *Production Practice*, p. 442 (1938).

[8] J. H. Henderson, and Alan H. Meldrum, "Progress Report on Multiphase-Flow Studies," *Producers Monthly*, Vol. 13, No. 5, March 1949.

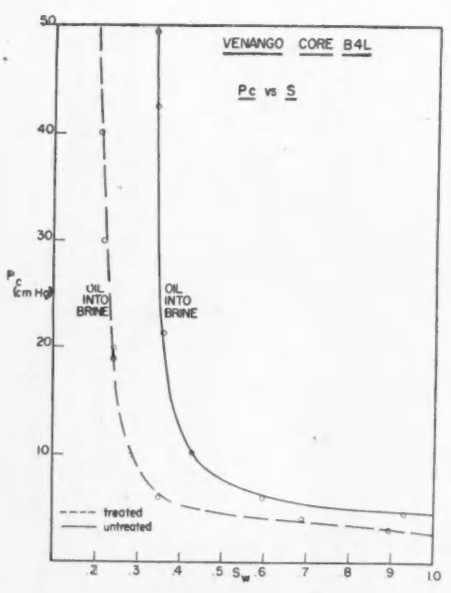


FIGURE 7.

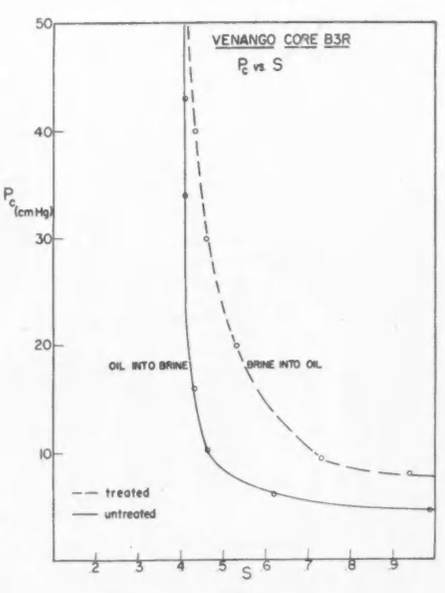


FIGURE 8.

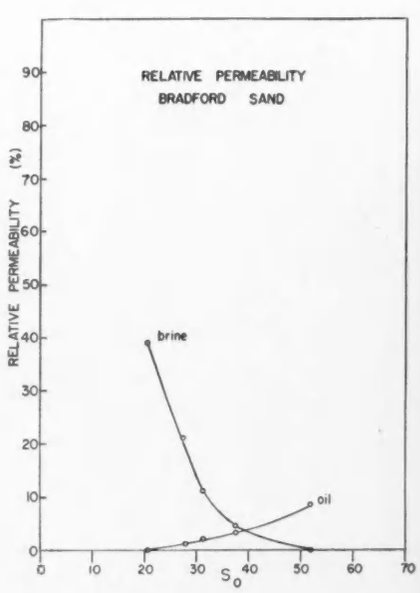
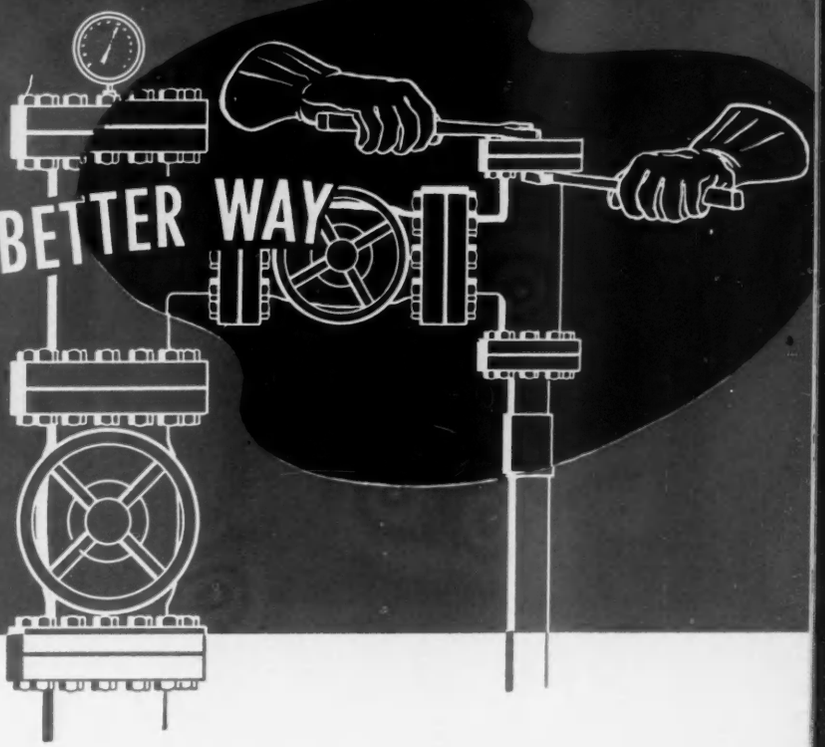


FIGURE 9.

UNIBOLT PROVIDES A BETTER WAY TO DO THIS JOB!



UNIBOLT TEE OR CROSS WITH BLANKING PLUG—available in any desired combination of inlet and outlet sizes and pressures.

UNIBOLT POSITIVE CHOKE—release only one bolt to change chokes in this regular UNIBOLT Choke Body fitted with UNIBOLT Flow-Rated positive bean and Blanking Plug.

UNIBOLT ADJUSTABLE WING VALVE—can be assembled in manifold for flowing with or against the stem. Provides economical wing valve, with unrestricted flow, for shut-off while changing beans.

Employing standard UNIBOLT connections rather than flanges, the UNIBOLT Manifold is many pounds lighter, yet the unique UNIBOLT design, which places more steel in shear, actually results in a higher factor of safety for the manifold.

Here are other reasons why more and more operators are specifying UNIBOLT Flow Manifolds as a better means of controlling well flow: (1) Units of the manifold . . . Unibolt Adjustable Wing Valve, Unibolt Positive Choke Body, and Unibolt Tee or Cross . . . are pressure-tested as a unit and may be assembled in a number of combinations to best meet individual requirements; (2) Any desired volume of well flow may be accurately achieved with UNIBOLT Flow-Rated Beans, which are available in flow increments of 5% and 10%, or in standard fractionally drilled sizes; (3) Lower first cost and maintenance; (4) All parts may be safely and easily replaced in the field; (5) Its units are completely interchangeable; (6) The manifold is completely salvageable; (7) It is available in regular forged steel or in high-chrome alloy for corrosive wells—6000 lbs., 10,000 lbs. and 15,000 lbs. test.

UNIBOLT
THE ONE BOLT COUPLING

THORNHILL-CRAVER COMPANY

Houston, Texas

Maintenance of Water-Flood Meters

By H. O. PROSKE

Rockwell Manufacturing Company
Pittsburgh

A REASONABLE approach to proper maintenance of water-flood meters is primarily a simple brief explanation of the meter, its parts and their functions. A meter should be considered a measuring instrument and treated accordingly. It consists of two major units. The outer shell or case consists of the register box and register, the main case and bottom case. The measuring element on the interior consists of the measuring chamber with nutating disc; and its component part, the intermediate gear train assembly.

The measuring chamber is the heart of the meter. Its interior is a carefully machined bronze chamber with an inlet and outlet port divided by a division plate. Within the chamber is placed the disc, a carefully balanced and machined hard rubber assembly consisting of a lower half ball, the flat disc, and the upper half ball held in place by the disc spindle.

Actuation of the disc is caused by the movement of fluid through the inlet and out of the outlet port causing a predetermined displacement of fluid by each nutation of the disc. This action is carried through the intermediate gear train assembly which in turn accentuates the stuffing box spindle to the register. Every consideration should be given to careful meter repair, especially the accuracy of its operation at low flows. This is especially important in the measurement of water on wells that have a low daily production.

Suggested Procedure

To effect the best results, one or more men should be assigned the responsibility of proper repair procedure. Inexperienced persons trying to repair meters can cause much needless expense and much unnecessary meter repair replacements costs.

Fundamental needs for meter repiar are the following:

A clean work bench with proper safe tools.

Covered receptacles containing good metal cleaning solution and neutralizer.

A means of testing and calibrating the meters after repair.

When the meters are brought in from the field, they are dismantled by first removing the register box assembly for inspection. This prevents damage to the register and will make reassembly easier. If desired, a metal cleaning dip may be used on the outer case, but usually buffing with a wire brush is considered satisfactory. Disassemble all the parts in the measuring mechanism and examine for existing wear.

A convenient way to dip the parts to be cleaned is to make a copper basket which can be safely lowered into crocks or vats containing a cleaning solution.

There are a number of good cleaning solutions available to meet requirements, and close attention to the instructions as to their use as set forth by the manufacturers will give excellent results. Some cleaners require a neutralizing agent, and if the manufacturer so specifies, be sure to use it, as acids that are not neutralized continue their action and eventually destroy the metal.

The measuring chamber is machined to close tolerances within a few thousandths of an inch; consequently, overlong submersion in the cleaning solutions may destroy this accuracy. Never use a buffing wheel or

WATER-FLOOD METER maintenance is greatly simplified if the parts of the instrument, and their functions, are fully understood. For efficient and economic repair of meters, the author suggests a procedure to be followed by shop and field men. Methods of cleaning, testing and transporting meters are recommended.

emery cloth on the interior of the measuring chamber.

Half balls on the disc are removable and interchangeable; consequently, wear on this part of the disc assembly doesn't necessarily mean that the entire disc must be replaced. The intermediate gear train is of simple design, incorporating rugged construction; consequently, inspection of the spindle bushings and the gears is relatively easy to make. On oil-enclosed gear trains be sure that pressure balance holes are open to insure proper balance of pressure inside the oil train case.

The driving spindle driven by the intermediate gear train passes through the upper part of the main case, through the stuffing box assembly. Adjustment of the stuffing box nut after the stuffing box packing replacement should be such that it does not bind the driving spindle.

Testing of Meters

After the meter is assembled, it should be tested for accuracy at variable rates of flow, ranging from ¼ to 15 gallons per minute. There are several methods of testing meters on elaborate provers or scales, but the most expedient is to install a new meter in the water line and follow it with a tapered lubricated plug valve, followed by a simple connection to which the meter to be tested can be attached. The outlet piping of this meter should discharge at an elevation higher than the top of the meter. Carefully repaired meters can be made accurate to within plus or minus 2 percent or even closer, and this is important since a large number of water floods are on low daily production.

Storage and Transportation of Meters

While in storage or transit the inlet and outlet of the meter should be stopped with corks so as to prevent damage from dirt and dust. Foremen and field men should be given instructions as to the correct installation of the meter and the proper procedure in bleeding the air from the meter before it is placed in service and line opened fully. Considerable replacement and repair can be prevented by placing additional strainers in the line ahead of the meters. By complying with the above suggestions the waterflood operator can be assured of an accurate and determined water input check which is one of the essential conditions in an economic and effective oil recovery from marginal oil leases subject to metered water injection.

Hamstring High-Pressure Problems

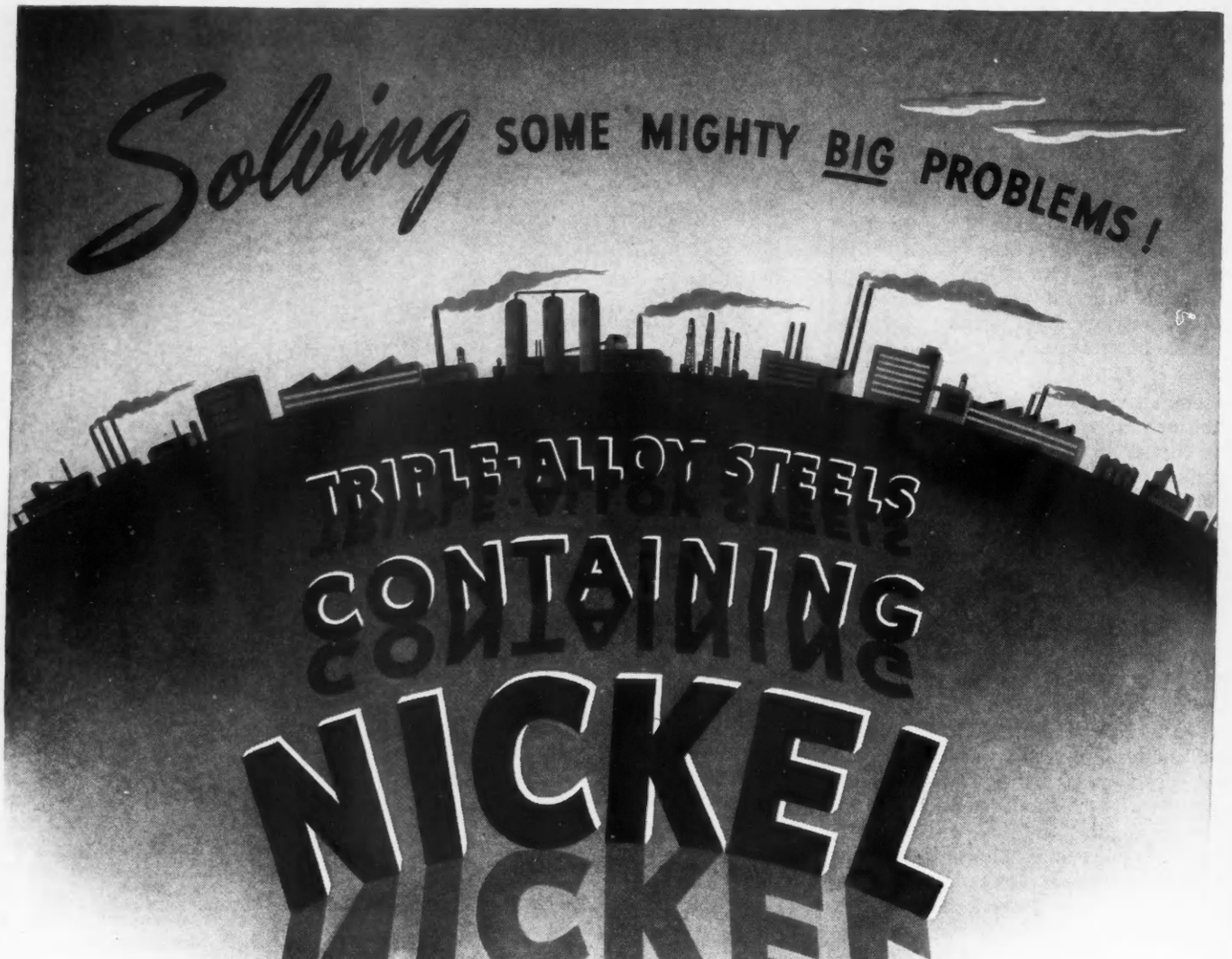
before they occur

"Keyed" Landing Nipples and Locking Assemblies

for Otis Sub-Surface Pressure Controls

Operators sometimes call this Otis down-well equipment "selective" nipples and mandrels because of a "keyed" locating and locking principle that provides a safe and positive method of installing Otis production tools in as many as five different places in the same string of tubing. As high-pressure wells are being completed, or when tubing is rerun after repairs, one or two—or as many as five—corrosion-resistant Type S Otis Landing Nipples can be made up as part of the tubing string. When required later, Otis Removable Bottom-Hole Chokes, Regulators, and Tubing Safety Valves attached to a "selective" locking assembly can be run in (on a wire line, under full shut-in well pressures) and set at the desired depth in the string. Each "keyed" locking device, and the production tool it carries, will pass through all upper landing nipples until the mandrel "selects" its correspondingly-keyed nipple. Contact your nearest Otis engineer for complete details and illustrated technical literature. *Otis Pressure Control, Inc., Box 7206, Dallas; field offices in* Houston, Corpus Christi, Victoria, Falfurrias, Longview, Odessa, Oklahoma City, New Iberia, Houma, Brookhaven, and Caracas, Venez.

Otis - outstanding in the Industry for pressure control



● The widespread use of triple-alloy steels containing Nickel, chromium and molybdenum is based on extensive experience in widely divergent engineering fields.

It has been found that they can be counted on for consistent performance. The depth to which full hardness is developed is comparable to that attained by other alloy steels. Their response to heat treatment is dependably uniform.

Moreover, the wide range of compositions available, makes it possible to select *accurately* suitable alloy steels for a broad range of applications.

Inquiries regarding the selection and uses of triple-alloy steels containing Nickel are invited.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street New York 5, N. Y.

Fracture Spacing In Recovery of Repressured Oil

By F. R. COZZENS
Field Foreman, Equity Oil & Gas Company, Stockport, Ohio

THE AUTHOR develops the theory that excessive shooting of formations can cause loss of production through creation of blocked areas and the opening of channels through which repressuring agents can break through to the well before sweeping the entire pay zone. He outlines shooting methods to control fracturing, and recommends strength of shots to obtain desired drainage pattern.

AS THE principle is utilized in secondary recovery, sand-fracturing processes gain oil by losing oil, and the ratio of gain to loss over a given acreage is initially instituted when its productive wells are shot. The basic purpose in shooting a prospective well, as commonly understood, is to equalize sand permeabilities as far as possible by creating a radius of fissures around the bore, so that oil may be retrieved from an area of greater dimensions.

Oil is recovered principally by master fractures, produced by strain waves which are assumed to extend out into the sand as spokes in a wheel, or on lateral planes, parallel to the wellbore. Except as a general directional course, however, the term "parallel" is somewhat misleading, since the coring of fractured strata reveals that major fractures divide and subdivide to form horizontal and angular fissures which wholly or partially envelop much of the strata within their radius. Thus a major fracture, starting as a crevice at the wellbore, often terminates with a dozen or more tips, and may encircle segments of sand ranging in size from an inch or less to several cubic feet. When an oil head backed by a repressuring agent reaches the tips or margins of a pattern thus fissured, the course of least resistance is followed which, logically, is through the fracture channels around and between the sand segments to the producing well. Since the well must remain open for pumping or flowing, a substantial pressure head can not be established within the fissured area, and little or no energy can be diverted from the channels against the surrounding sand. Consequently, the disrupted segments which comprise most of the area are bypassed, and the oil content, except for a minor portion which gravitates to the well, is lost or sacrificed to the process of fracturing.

No sand-fracturing procedure can be completed without creating some bypassing action, and since no two wells respond alike to fracturing energy, there is no equation by which individual oil losses can be computed. Compensation for such losses is based upon the fact that in making the sacrifice, the sand-bore radius of four to six inches has been lengthened to 20 or more feet, and the drainage area enlarged 10 to 20 times its original capacity. Physical calculations would therefore tend to prove that for each barrel of oil lost within the fractured area, 100 or more extra barrels could be recovered from around its margins. Unfortunately, faulty manipulation of the same fracturing process can, and often does, alter calculations to an extent where 100 or more barrels of pattern-oil are sacrificed without sufficient marginal gains to equal the loss. The basic principle is applicable in either direction, and the resultant ratio of gain to loss is determined, not by the physical capacity of the pattern, but by the length and distribution of its fractures. A few fractures widely scattered up and down a sand bore will, with their appendages, envelop and immunize nearly as much strata as would be the case were the bore fractured uniformly from top to base, yet the oil retrieving capacity is limited to the occasional, lengthy fractures which form the margins of the pattern. Inability of a few fractures to recover any major portion of an oil head is commonly exemplified in producing wells which have been shot too lightly. In certain zones of oil-bearing strata, a nitroglycerin concentration of less than three quarts per foot of sand is sufficient to create fractures several feet in length, while other zones, faced by an equal charge, receive only short fractures, or none at all. The few fractures which extend into the sand to any practical depth can receive only that portion of an oil head in closest proximity to their tips.

This allotment of oil is followed by the repressuring agent (air, gas, or water) and terminates in a premature pressure break-through at the producing well. From thence on, the agent moves faster than the oil, crowding it back, and occupying more and more channel space, until the ratio between oil and agent becomes too wide for economic production. The well must then be closed in or plugged. A part of the remaining oil head can be pressured, perhaps, to a neighboring producer. Much of it remains trapped around the margins of the crippled pattern, and is ultimately lost, along with that sacrificed originally in making the pattern.

Widely spaced and scattered fractures along a sand-bore are more detrimental to an economic oil recovery than no fractures at all, because oil is lost in making the fissures, and by their inability to retrieve sufficient marginal gains. Logically, the basic solution to this problem is greater concentration, and a better distribution of fracturing energy against the sand face. This remedy does not assure a uniformly fractured sand bore, however, without mechanical aid, and eastern operators who use heavy shots successfully have discovered, that for most effective re-

sults, all shots must be supported by: (a) bore preparation; (b) protective measures against shattering; (c) fracture clearance at the initial cleanout. With these three factors in mind, supporting measures are instituted on a prospective well when the top of the pay sand is reached. At that point, the diameter of the final reducing shoulder is kept as large as possible. The sand from top to base is cored, or drilled through with a stub bit, held fully out to gauge. This procedure assures a smooth sand bore, without pimples or tight, restricted spots, which often pinch a torpedo shell and prevent its seating at the proper location. Any undesirable sand at the base of the pay is plugged off, and the remainder of the bore is washed out thoroughly with salt water or brine. Steel line measurements are taken, and any zones of exceptionally high permeability sand are spotted on the well log. Fracturing results are generally more favorable if the newly-drilled bore is allowed to stand 24 to 48 hours, and bailed out at intervals, before shooting.

Liquid nitroglycerin (white or red) is the fracturing medium most preferred, providing the zones of tightest (low permeability) sand will accommodate a sufficient shot-concentration without bore enlargement at those points. Most favored is a 5½-inch diameter shell, which is equivalent to a shot concentration of 4.94 quarts per foot. If areas of very soft or porous sand are present, the shell is tailored (reduced in diameter) through these zones to allow a facing concentration of three to four quarts per foot. This is done to reduce shattering, and another favored plan is to break up the charge and resultant shock-waves through porous zones by using short (three- to six-inch) spacers between shells. Spacers are used also against beds of shale or slate, which may occur along the bore between layers of sand. Such deposits should remain unshot, and if their thickness is extensive (three feet or more) it is often advisable to shoot the sand bore in separate units, running the top shell after lower ones are detonated. At certain locations, particularly where the pay strata is lensing out, or of conglomerated nature, red nitroglycerin, or some of the newer gelatin types of explosives, appear to give better fractures with less shattering than does straight (white) nitroglycerin.

Precautions are taken so that the top of any shell or explosives pack when seated in the sand bore does not extend above a level of 2½ feet below the casing shoulder or final reducing point at the sand top, and before the shell is run, the bore is bailed dry as possible. Most shells are provided at the top with an umbrella bridge, and when seated correctly, as attested by measurements, the shell-covering or bridge is backed up with 12 to 15 gallons of slurry (clay, cement, or other hydratable material). This is done mainly to prevent fluid seeping into the bore around the shell from rising into the annulus above it. No other stemming is used, and the charge is detonated electrically as soon as the slurry has attained its initial set.

Sand Bore Cleared

Immediately after firing and when resultant gases have diminished, the sand bore is cleared of residue to permit regurgitating action from the newly created fractures. Cleanout fluid is dense salt water or brine, and only enough used to keep the residue in good bailing condition. Stirring is best accomplished with a short bit, held slightly off bottom during the process. As cleaning progresses, the well is allowed three to five standing or dormant periods, of 10 to 12 hours each, to permit clearance of the smaller pores by drainage, and to accommodate the initial caving, or sloughing-off of the sand face surface. After each standing period, as much oil as possible is bailed off before the residue is stirred. Otherwise, an oil-water emulsion, infused with powdered sand, may cause plastering or plugging of the smaller fractures. When the sand column ceases to emit any practical quantity of residue, and the bore remains clear to base after a standing period, a pocket is drilled to a desired depth, and the new well made ready for pumping.

Many old wells being converted into secondary producers were fractured faultily through trial-and-error shooting at the beginning of their primary production. The physical outline or profile of a fractured pattern thus established can never be changed radically by any technique known, but sparsely fractured or unfractured zones can be benefited to a considerable extent by reshooting. Upon wells located at strategic points on a repressured property, such corrective efforts are often practical and advisable.

Preparatory to reshooting, old wells are given a brief but effective cleanout. The cleaning fluid (brine) is preferably heated to remove as much sludge and paraffin as possible from the sand face, and any impediments, such as broken tubing, etc., found in the shot hole are fished out. The bore is cleaned to its base of all accumulated sand, etc., and if the residue shows a high proportion of shale or slate, indicating that extensive fracturing has occurred above or below the pay sand, such stretches of annulus are cased or plugged off. The mouth of any existing pocket is bridged before the bore is reshot. The number, length, or location of fractures along such bores cannot be determined by surface calculations, but if authentic well records are available so that tight and restricted sand zones can be spotted, it is generally conceded that such areas were least affected by the original shooting. The favored procedure is to refracture these zones, using stub shells with a nitroglycerin concentration equivalent to at least five quarts per foot of sand. Very soft or porous sand in old wells is not reshot, and where base water is present, it is usually not advisable to reopen fractures along the lowest three to five feet of pay.

Where no reliable well records are available, reshooting still remains a more or less trial-and-error procedure. For uncharted wells, some operators favor gelatin dynamite, 40 to 60 percent strength, as the refracturing agent, contending that a sand column partially depleted of fluid during primary production is fractured more uniformly by explosives of lower velocity. Field tests are as yet too few and scattered either to refute or confirm this theory. In the majority of fields, however, the practice is to reshoot such wells with liquid nitroglycerin in shells of diameters as large as can be run safety through the sand bore. Followup cleanouts are the same as practiced on newly-completed wells, except that more cleaning brine is necessary because of the greatly enlarged bore.

Many old wells (and some new ones) are shot and fractured too lightly because the final reducing point at the sand top is of a diameter too small to permit running of a shell of sufficient size. Such bottle-necked bores are mechanically corrected with solidified nitroglycerin, preferably gelatin, 100 percent strength, used in what are commonly termed 'pack-shots.' Two or more charges are necessary in treating a sand bore. The first, or initial, charge is a pack of 15 to 25 pounds, its purpose being to enlarge the bore (below the sand top) so that the main or actual fracturing charge can be introduced.

The loading procedure, which in all cases should be supervised by a competent well-shooter, is to dip the

It doesn't have to be this way...

. . . CAN'T BE GAS LOCKED—ISN'T BUMPING—MAYBE THE STANDING VALVE'S LEAKING—ENGINEERS SWEAR IT CAN'T BE PUMPED OFF—KNOW THE RODS HAVEN'T PARTED—GUESS WE'D JUST GOT TO PULL IT AGAIN—
BOY, HE'S REALLY SWEATIN' IT
BETCHA IT'S THAT SQUARE STANDIN' VALVE BALL AGAIN
MAYBE THERE'S A KNOT IN THE RODS
NAW, YOU JERKS JUST RAN THE PUMP UPSIDE-DOWN WHEN I WAS OFF LAST WEEK

It can be like this!

LES'SEE, 13'S JUST STARTING TO POUND, WE'LL SLOW IT DOWN. FLUID'S BUILDING UP IN 8, BETTER SPEED IT UP A LITTLE. THE PUMP IN 12 IS GETTIN' PLUGGED WITH TRASH AGAIN, I'LL START IT OUT BEFORE I EAT LUNCH. Y'SEE, YOU CAN READ THOSE FREE PUMP WELLS LIKE A BOOK.
KOBE

...Free Pumping Makes the Difference!

Goodbye, guesswork! With Kobe Free Pumping you get accurate, right-now information on bottom hole conditions just by reading a dial. Furthermore, you can solve any of a dozen common pumping problems by the turn of a simple valve... It's easy, too, for one man to surface and service a Free Pump—in minimum time and regardless of weather. In all, you get down-to-the-last-drop efficiency because of the greater flexibility of Free Pumping to meet every change in well conditions.

But easier trouble shooting is only one of the many advantages offered by a Kobe hydraulic Free Pumping system. Kobe spells over-all economy in a big way. Operator after operator reports reduction in pumping costs from 15 to 40%, plus savings on equipment up to $5000 per well... Don't guess any more. Let your Kobe representative prove how Free Pumping gives you both the facts and the profits.

Free Pump
KOBE
ONE OF THE DRESSER INDUSTRIES

KOBE, INC. *General Offices:* Huntington Park, California. *Division* and *District Offices:* Avenal, Bakersfield, Huntington Park and Ventura, California; Great Bend, Kansas; Hobbs, New Mexico; Healdton, Oklahoma City, Tulsa, Oklahoma; Brownfield, Corpus Christi, Fort Worth, Houston, Kilgore, Odessa, Texas; Casper, Wyoming; New York City.

gelatin cartridges in oil, after wrappers are removed, and to introduce them into the bore with a dump shell, which can be 10 to 30 feet long, and of a diameter as small as three inches. Gelatin thus introduced firms into a solid and concentrated pack at a specified location, without tamping. The diameter of restricted bores can often be enlarged three to five inches by such initial or preparatory charges without disturbing casing shoulders or final reducing points at a sand top. If certain zones require heavier shooting than others, cavities can be made at specified points by bridging the bore a few inches below them, and detonating the initial charge from the bridge.

In the reshooting of old wells, having rough, bellied-out shot holes, the bridges are usually supported from the base of the annulus by drillable pipe, cut in required length, or by similar supports which can be easily drilled out. Since 3.32 pounds of gelatin, 100 percent strength are equivalent to approximately one quart of liquid nitroglycerin, the size and strength of the main or fracturing charge can easily be computed by the number of pounds which can be packed into the bore cavity after enlargement. By thus increasing the diameter of the bore as a unit, or at specified areas by subsequent initial charges, any shot concentration desired can be applied to a linear foot of sand face without enlarging the annulus at the sand top, and by such process a fracturing charge of 300 to 500 or more pounds of gelatin can be introduced through a bore opening which normally would admit nothing larger than a three-inch diameter shell, or a liquid nitroglycerin concentration equivalent to less than two quarts per foot of sand. Fracturing properties of high strength gelatins are considered equal to those of liquid nitroglycerin, and there is very little if any difference in time required for cleanouts.

When a carefully designed charge of explosives of an approved type has been detonated within a sand column, it seems logical to assume that the resultant fracture channels have extended equally in all directions, so that the disrupted area of strata around the well bore is enclosed by a near-perfect circle. If this were true over any considerable acreage, the strength of a shot or shell size could be used or equationed as a function of permeability ratio, whereby producing could be spaced so as to assure uniform and complete sand-drainage between them. Unfortunately, due to physical dissimilarities, unforeseen and beyond control, structural resistance is rarely if ever equal at any two bore points facing an explosives charge. Fractures may extend 30 feet in one direction from a sand bore, and five feet or less in another, and their marginal tips could create a profile of any shape imaginable. However, if the fracture tips reaching the margins of such a profile are liberal in number and closely spaced, the oil-retrieving capacity of the radius is equal to that of a complete circle. Fracturing processes are designed, not to shape the contour of a fissured area, but to increase its retrieving effectiveness through the making of more and stronger fractures. A liberal number of capable fractures, spaced and distributed along a sand bore in accordance with its linear footage, will receive a very high percentage of any oil head pressured against them, and less oil waste occurs within the fissured radius because in the making of more fractures, disrupted strata is broken into smaller segments so that fluid drainage into a well is more complete. Greater retrieving ability along the margins of a fractured pattern, plus reduction of waste within it, brings the ratio of gain to loss into better working alignment, and consequently, through the system as a unit, more oil is recovered at less expense.

'FLEXITE' Plungers

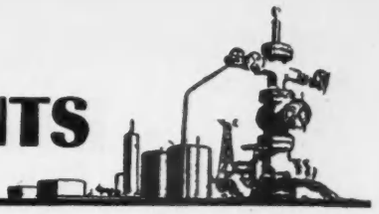
are especially efficient in wells making a high percentage of water, hot salt water brine... for pumping high-sulphur crudes... or as an all-around plunger for pumping average wells. The patented Flexite ring—a hard, fabric-reinforced plastic—will not corrode, swell, or disintegrate. Flexite rings are impregnated with graphite to provide their own lubrication. Their sealing action is effected by a built-in inner tension of the special composition material. Pressure from the fluid load forces the rings to a positive seal against the pump bore; on the down-stroke they release the seal gradually, which reduces sudden shock and strain on the rods. Flexite Plungers are available in all standard A.P.I. sizes for regular or sectional liner barrels and for tubing or rod pumps. Plungers with Monel metal parts for sour crudes, or with stainless steel parts for corrosive salt water, are available if desired. Flexite Plungers and other H-F down-hole pumping equipment is sold from stock by leading supply stores in all major producing areas.

HARBISON-FISCHER MFG. CO.

2501 Virginia Street, Fort Worth, Texas

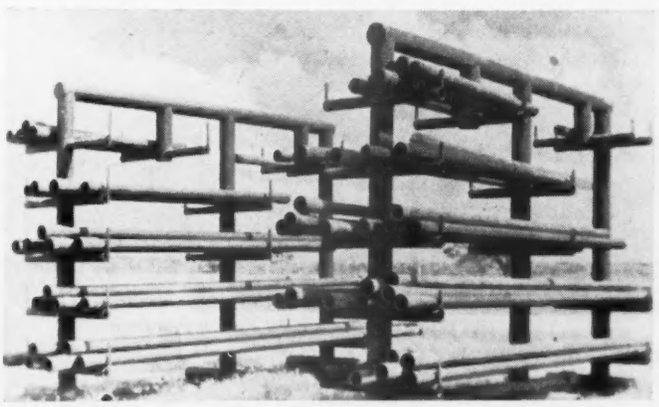
Pumps • Balls-and-Seats • Stuffing Boxes • Oil Savers • Polished Rods

How to do it! PRODUCTION HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

HOW TO—Make Rack for Storing Tubing Pup Joints



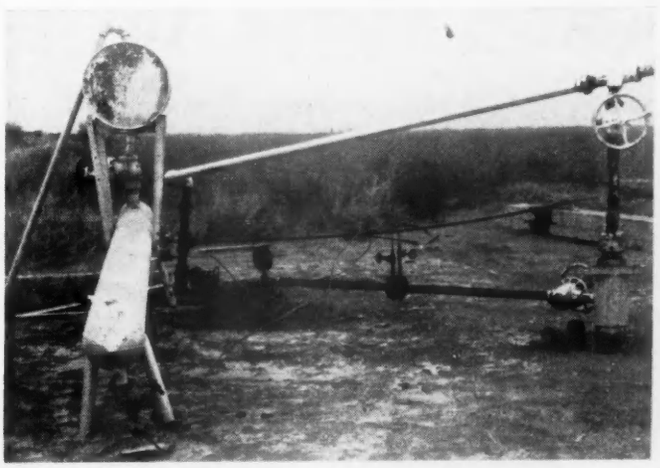
The storage of surplus pup joints on the lease, in warehouse stock or in the pipe yard is an annoying and vexing item of material handling. Many places where they are normally stored often prove inadequate. They are often placed on top of pipe on a rack, only to fall through to the ground when pipe is moved or rolled from the rack. Again, they are often thrown on tool docks or platforms where they are bent or the threads are mashed when struck by heavier pieces of equipment.

This simple rack was designed to provide more accessible and neater arrangement of tubing pup joints than other more haphazard places of storage. A most desirable feature of this rack is its portability. It can easily be moved from place to place as the focal point of storing surplus pup joints may be changed or required.

This rack is made of ordinary four-inch and two-inch line pipe, welded together and made to a convenient height of six feet, and length of nine feet. Each rack is made of three vertical members welded at the bottom to a foot piece measuring about 40 inches long, and securely welded to the nine-foot section across the top. The center four-inch upright is spaced four feet from one end and five feet from the other. Between this center member and the outside supports is welded a 4 x 14-inch nipple, centered about 15 inches from one end. A similar nipple is welded about three feet from the end. These two short vertical lengths of pipe form the first deck structure for holding both the two-foot and 4-foot pup joints.

Lateral pieces upon which joints are stacked are made of two-inch pipe, 11 inches long for the two-inch rack, 14 inches long for the 2½-inch rack, angled and welded on opposite sides of the three column supports. The rack is completed with lengths of ⅝-inch or ¾-inch sucker rod material welded to the outer ends of the lateral pieces to form chocks to retain the pup joints.

HOW TO—Add Corrosion Inhibitor to Gas-Lift Wells



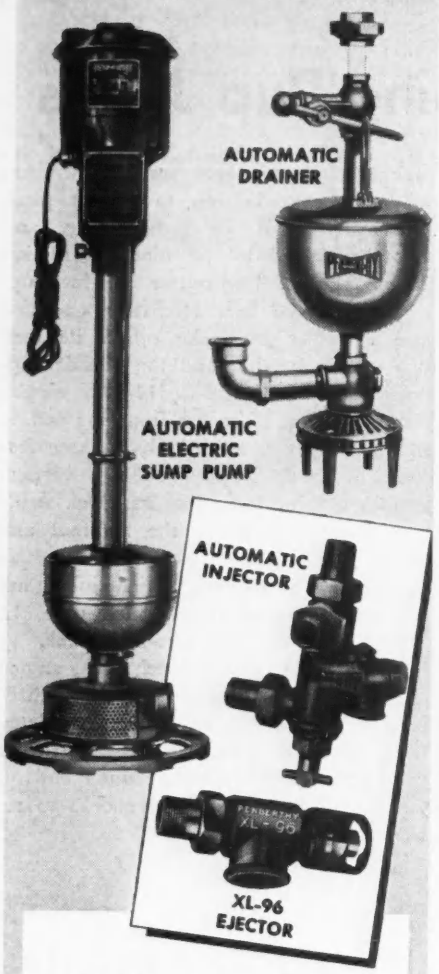
Where corrosive fluids are produced, it is sometimes necessary to have an inhibitor in the stream from the time that the fluid first enters the well bore.

One arrangement uses the orifice flange on the gas input line to "meter" the amount of inhibitor used in the well. The inhibitor is added to the gas stream and tends to prevent corrosion on both the outside and inside of the tubing, also protecting the gas-lift valves.

As shown, the inhibitor is placed in a section of eight-inch pipe with the ends orange-peeled shut to withstand the casing head pressure. This vessel is placed on a sloping stand with a drum mounted above it for storage of inhibitor. A high-pressure gate valve is placed between the vessel and the drum and is kept closed while the inhibitor is running into the well.

A drain is placed on the bottom and the connection to the well connected to the drain pot. Another connection is made on the side of the eight-inch pipe and this line is connected to the upstream side of the orifice flange which is also used for periodic input ratio tests. The other line from the drain pot connects to the down-stream side of the orifice flange. As the gas flows through the orifice, it creates a differential in the vessel and the inhibitor is drawn into the well at the same rate that the input gas is used.

PENBERTHY
Quality Products



Penberthy Automatic Electric Sump Pumps and Penberthy Automatic Drainers (water or steam operated) have demonstrated their superiority wherever seepage water accumulates. Simple rugged design—copper and bronze construction throughout.

Penberthy Automatic Injectors assure an uninterrupted supply of feed water to oil field boilers at minimum cost. Reliable under most severe operating conditions.

Penberthy Ejectors use the power of steam, air or water under pressure to lift liquids. No moving parts—no lubrication. Also used as water heaters.

3277-A

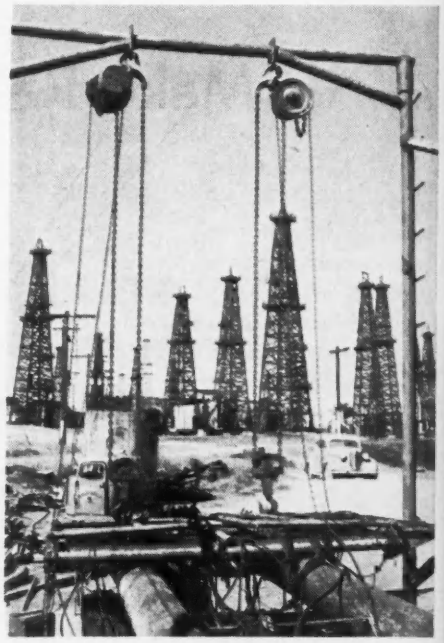
PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant—Windsor, Ontario

HOW TO—Store Pulling Unit Mast

The uses to which a pulling unit can be put may be increased if the large, bulky mast can be removed when desired. In many fields, some wells are equipped with production type derricks, in which case a mast on a pulling unit is not required. In the same field there may be wells on which there are no such derricks, thereby necessitating the use of a mast.

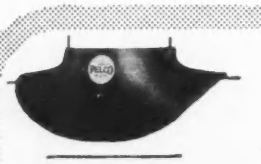
It is possible, on many units, to remove the mast when only the hoist on the pulling unit is needed. Considerable time can be saved in removing the mast as well as loading it back on the pulling unit if adequate facilities for storing it are available.

Here is an idea that makes it possible to use a pulling unit on either type well, that is, one equipped with a derrick or one not so equipped. The mast lies flat on top of the unit, resting on a frame support mounted in front of the unit. It is held in place at the rear by the base hinges.



For this purpose, two hoisting frames, such as the one shown, were erected in the warehouse yard, whereby the unit could be driven under the frames and the mast dismantled from the truck. The hoisting frames consist of four perpendicular legs of four-inch pipe that are firmly cross-braced. They are tied together at each end and braced as shown. Two chain hoists are supported at either end to lift and lower the heavy mast.

The mast is shown lying on large timber blocks, with the hooks from the chain hoist remaining in place. When the mast is needed on a well pulling job, the hoists are raised, each operated by one man so that the mast can be raised evenly on all sides. When the mast is at the proper height, the truck is driven beneath it and the mast is lowered into position. Only the string-up lines need be removed from the mast when making this transfer, and little time is required to restring when resetting the mast on the truck. The guy wires and double board remain on the mast.



Specify PELCO Welding Saddles

PELICAN WELL TOOL & SUPPLY CO.

P. O. Drawer 1108
Shreveport (84), La.

SEE YOUR NEAREST SUPPLY HOUSE

for Better Pumping!

This easy-starting Fairbanks-Morse "ZC" Engine gets your pumping rig off to a good start . . . *even on the coldest mornings.* Fairbanks-Morse High Tension Magneto supplies a "hot" spark that eliminates costly starting delays. There are no complicated parts in a "ZC" . . . no delicate adjustments to cause trouble. Maintenance is simplified, and costs are exceptionally low. Stop in at your supply store and see the Fairbanks-Morse "ZC" . . . the economical answer to any pumping problem. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE,

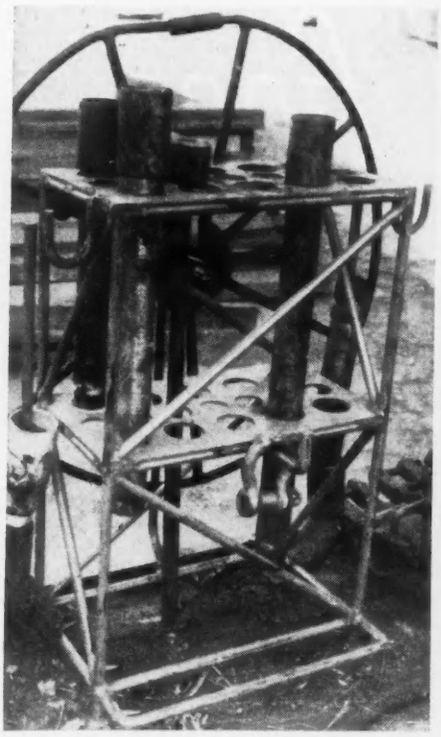
a name worth remembering

"ZC" ENGINES • PUMPS • ELECTRIC MOTORS • LIGHT PLANTS GENERATORS • DIESEL AND DUAL FUEL ENGINES • SCALES

HOW TO—Save Storage Space on Well Pulling Truck

In order to perform every job required on a well or tank battery or flow line, the gang truck must be fully equipped with material and a variety of tools. Such a variety of items to be carried by one truck, which in most cases also transports the crew, presents a storage problem.

To make the most of the limited truck bed space on the unit used to pull wells, the illustrated shop-made tool rack was made. Since the rack measures only 12 inches by 24 inches by 36 inches high, little of the available space was required, yet the rack is capable of holding the rod elevators, rod wrenches, rod wheel, tubing nipples of several sizes, tubing tongs, and many other odds and ends used in working on a well, even including a broom.



The rack is easily fabricated from used sucker rod and boiler plate material. As many hooks and eyes can be attached to the rack as there is space to weld them to the upper bracket. The rack is well braced on all sides, and contains boiler plate decking on top and at the middle. Various size holes have been cut into these plates to accommodate different sizes of nipples and tubular goods. Collars on the end of long nipples hold them in place. Lower holes serve to stabilize these items during the rough trip to and from the lease. Other rod pieces welded to extend upright are used to hang short nipples, collars, and other miscellaneous fittings.

It is advisable to securely bolt the rack to the truck bed with either U or J-bolts, for the amount of material that will eventually be carried on the rack will be considerable and could easily bounce off the truck. Apart from the greater availablity of the tools, there is greater worth of the rack as a safety item. It will eliminate falling of stacked tools or tripping on a cluttered truck bed.

Producers need not suffer high operating costs

Big power bills, high maintenance costs, and other expenses that cut into profits need not bother you producers. Because of oil bath lubrication, precision shaved gears, anti-friction bearings and mass production, Jensens are easy to buy and inexpensive to operate.

If you think your present production equipment is costing you too much to operate, then we have a suggestion: see your Jensen dealer or write to us in Coffeyville. We'll give you facts and figures on Jensen operating efficiency. Pick up your pencil right now!

JENSEN

Bros. Mfg. Co., Coffeyville, Kan.

Export Office: 50 CHURCH STREET, NEW YORK CITY

MARSH

... the gauge with the "Recalibrator"

Any pressure gauge can be knocked out of adjustment, but when it's a Marsh Gauge you can quickly correct it with the twist of the "Recalibrator" screw.

This is not only the handiest way to correct a gauge; it is also the best way. Conventional methods of adjustment simply compensate for the error. The "Recalibrator" corrects the relationship between the movement and the bourdon tube—actually *does re-calibrate* the gauge.

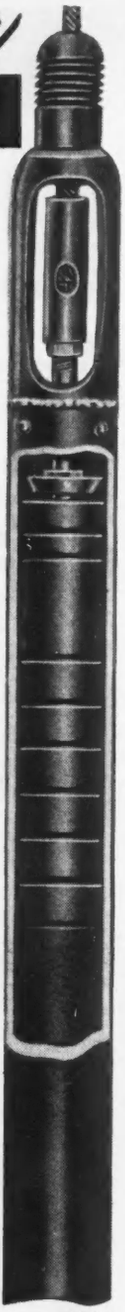
MARSH INSTRUMENT CO.

Sales affiliate of Jas. P. Marsh Corporation, Dept. K, Skokie, Ill.

Houston Plant, 1121 Rothwell St.

The Marsh line includes gauges especially designed for blenders, boilers, burners, capping, Christmas trees, columns, heaters, hydrogen units, instrument panels, pumps, Reid vapor bombs, scrubbers, separators, mud pumps, stills, towers and other applications including oxygen and welding gauges. Ask on your letterhead for new catalog just off the press.

Miller SAND PUMPS



In every major producing area where sand or sediment is a problem, you'll find Miller Sand Pumps and Bailers are standard . . . the leaders in clean-out equipment. For 26 years Miller has held this leadership, with continuous improvements and faithful service.

The Miller Sand Pump is made in regular and heavy duty types in sizes listed below. Lug type, chisel, sand and bailer bottoms are easily interchanged.

SAND PUMP and BAILER SIZES:

Outside Diameters

2½"
3"
3½"
4¼"
5"
5½"
7"

Lengths

20 feet
25 feet
30 feet

Special Sizes and Lengths Made to Order!

Write for new descriptive price list on Miller Sand Pumps and Bailers. See Composite Catalogue Page 3305 for details.

MILLER SAND PUMP CO.

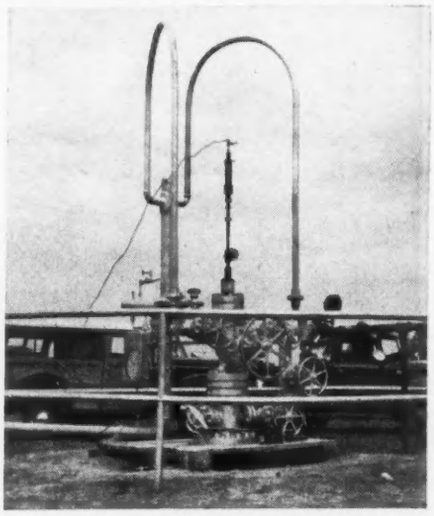
1524 S. E. 29 St. . . . . Box 4516
OKLAHOMA CITY 9, OKLAHOMA

EXPORT OFFICE:
30 Rockefeller Plaza-New York 20, N.Y.

PRODUCTION HINTS

HOW TO—

Connect Gas Well For High Pressures



High-pressure gas production always poses a problem in designing the flow lines and valve assembly for adequately handling the high pressures encountered.

The installation illustrated serves several purposes in a confined area that was easily enclosed by a circular pipe fence. The long-angle bends are directed upward instead of along the ground, thereby reducing the space inside which the connections are made. The well produces from the tubing, and flow lines are connected to both sides of the tubing flange cross, each side equipped with high-pressure valves.

The line fittings beyond the tee connected to the valves are all welded to preclude the possibility of leaks. Both two-inch lines extend upward for about six feet before entering into a long sweeping bend which has a radius of about 30 inches. Both lines converge on a four-inch vertical flow line which carries the gas from the well. The vertical section is equipped with an orifice meter which measures the volumes of gas produced into the system. It was mounted on the vertical section as shown.

The two smaller lines tie into the wellhead through high-pressure two-inch forged crosses, which are blanked off on two sides to form an ell fitting. A short vertical nipple from each cross ties into a union that simplifies the installation of the remaining lines.

For Complete Protection, Use

HERCULES

TUBING HANGERS

Because of the protection provided, no well should be "put on the pump" without installing a Hercules Tubing Hanger for suspending the tubing. All Hercules Tubing Hangers use the well known Hercules overhead packing arrangement. Made in all sizes to support up to 4" tubing. There is also available a Hercules type RH Hanger with means for packing off around both cable and tubing when used with Reda bottom hole pumps. To assure complete tubing protection, be sure to specify Hercules Tubing Hangers. Write for Bulletin.

HERCULES TOOL © TULSA

Sold at all Supply Stores

HERCULES TOOL COMPANY

Manufacturers of Oil Field Equipment

General Office and Plant:
17th and Phoenix
P. O. Box 286

TULSA, OKLAHOMA

Telephone 3-1186
Cable Address
"HERTOCO"

California Representative:
L. T. (Ted) WALTIMIRE
Phone 4-4169 - P. O. Box 1612
Bakersfield, California

Export Representative:
OIL FIELD EQUIPMENT CO., INC.
T. E. WARD, President
30 Church St., New York 17, N. Y.

Stop Losing Money with Old Fashioned Ideas

USE GAULIN Two Stage HOMOGENIZERS For Lubricating Oils and Greases

You can increase production, reduce costs and at the same time improve the quality of your products by using Gaulin Homogenizers for processes involving dispersions and emulsions requiring uniform size of 1 micron or less.

These heavy-duty, high pressure homogenizers *give you more capacity* and *use less HP* in the dispersion of additives in lubricating oils. They also cut costs in the production of soap type greases and new benton greases.

They are available in any capacity from 75 to 4000 gallons per hour with operating pressures up to 15,000 lbs. per sq. in.

Their rugged construction throughout assures long operating life with little if any maintenance. For example, the cylinder and all fittings with which the product comes in contact are of 302 or 316 stainless steel. Special spring-loaded design plunger packing insures maximum life and trouble-free operation. Special applications requiring specific metals and types of packing can be constructed to meet individual requirements. Valves and seats are made of either 302, 316 stainless steel, stellite or Hasteloy.

It will pay you to investigate Gaulin Homogenizers and High Pressure Pumps for your processes. Write for complete information and catalog.

Let's talk it over at the INTERNATIONAL INDUSTRIAL EXPOSITION
Booths 226-228
MARCH 11-17 HOUSTON, TEXAS

Gaulin TRADE MARK

MANTON GAULIN *Manufacturing* **COMPANY, INC.**
61 GARDEN STREET, EVERETT 49, MASS.

Is the Way
to Have

FREEDOM
from BOILER SCALE

Use Ounces Only
Once a Week of

SAND-BANUM
Pure Colloidal Concentrate
REMOVES and PREVENTS

•

ALL
Radiator Cooling Systems
Can Be Free From
Rust and Scale
EASILY
SAFELY
SURELY
Thanks to

SAND-BANUM SPECIAL
Concentrated Colloidal
Tablets

•

STOCKED BY
LEADING SUPPLY HOUSES

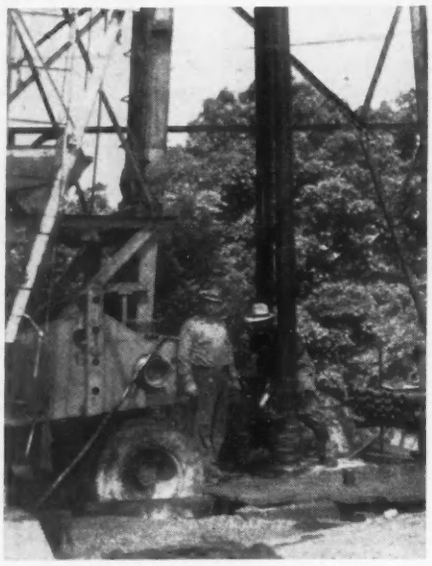
•

Send for Literature
on either or both

AMERICAN SAND-BANUM CO.
Established 1920
9 Rockefeller Plaza
New York 20, N.Y.

PRODUCTION HINTS

HOW TO—
Conserve Fluid When Bailing Flowing Well



Many wells in low-pressure fields are reworked with cable-tool rigs which do not have the advantage of overcoming pressure or fluid flow as does the rotary rig. On wells where a workover job may cause the well to flow slightly under low pressure, it has been found advantageous to use a special lubricator to conserve oil when bailing the hole. In the case illustrated, the well had been shot with nitro and it was necessary to clean out the debris left in the bottom of the hole. After the shot cleaned the bore face opposite the producing section, the well had a natural tendency to flow under a slight head.

Unless these special measures are taken, some oil would rise up the casing and flow over the working area around the rig. Instead of permitting such a condition to exist, a large lubricator was fabricated for the bailing operation which precluded such flow during the bailing job. The lubricator was made of about 8¾-inch pipe that was extended to a height necessary to fully enclose the bailer used. It was screwed into a collar attached to a short nipple inserted into the master gate valve.

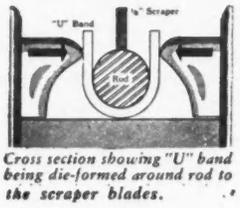
The valve was shut during the hooking-up operations, and the lubricator with the bailer inside extended into the derrick standing over the well. The bailer was run in the well with the sand line on the cable tool rig, and the line entered the lubricator through the top. Because the bottom-hole pressure was not sufficient to raise the fluid more than several feet above the master valve, it was not necessary to equip the lubricator with a stuffing box on top. There was sufficient space between the top of the lubricator and the crown block to raise the bailer.

THE *SURE* WAY TO ELIMINATE PARAFFIN ACCUMULATION IN PUMPING WELL TUBING

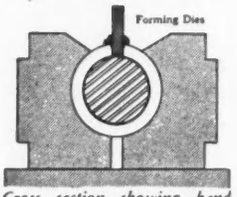
USE

CRALL
SPIRAL
PARAFFIN SCRAPERS

CRALL Spiral Paraffin Scrapers are designed to fit any sucker rod. They are sturdily constructed, but average only six ounces each in weight. Scores of major and independent oil-producing companies are now using CRALL Scrapers to their complete satisfaction.



Cross section showing "U" band being die-formed around rod to the scraper blades.



Cross section showing band held under pressure around rod while ends of band are shrink-grip attached to scraper blade.

1. Scrapers alternate — one right one left — eliminating tendency of the rod to unscrew.
2. No work at well. Scrapers are attached at our factory, and stocked at supply stores.
3. No maintenance costs. Pay for themselves in saving down time.
4. Made of thick, mild steel. Sizes to fit 2" and 2½" tubing.

The original installation is the only cost. Order your CRALL Spiral Scrapered rods from your supply store or wire, write or phone . . .

PETROLEUM SPECIALTY CO.
P. O. BOX 1640, PAMPA, TEXAS
Manufacturing and Fabricating Plants
at Pampa and Sundown, Texas.

Hydrocarbon Dewpoint Control by Gas Refrigeration

By J. T. SIMON

Chief Petroleum Engineer, Mountain Fuel Supply Company, Rock Springs, Wyo.

CONTROL of liquid slugging in the pipe line is necessary to uniform operation and the prevention of damage to equipment. The author outlines the refrigeration equipment installed and its functioning to control dewpoint in a gas which must be transmitted through lines with low winter ground temperatures, and illustrates the effectiveness of such control.

THE necessity for low hydrocarbon dewpoint for natural gas becomes almost as important as low water dewpoint in gas transmission lines. This is particularly true in areas where winter ground temperatures approach 30° F. In many instances, gas flowing from a well may remain or be maintained above the hydrate temperature until it is metered or water is removed by a dehydration plant. The gas then enters the transmission line at a relatively high temperature and as it moves down the pipe line its temperature progressively declines until the temperature of the flowing gas is the same as the normal ground temperature.

The distance the gas travels before it reaches ground temperature depends upon its velocity as well as the type and condition of the soil. This temperature drop in a raw natural gas will invariably cause the condensation of hydrocarbon liquids which accumulate at points of low elevation in the pipe line system. Over a period of time, this accumulation can reduce the pipe line efficiency to a point where it is necessary to take the line out of service in order to allow the liquid to run back to low spots where it can be removed by blowing to the atmosphere.

The elimination of liquid hydrocarbons from gas transmission lines may be accomplished by several methods. Most satisfactory method is to remove these liquids by processing the gas prior to its entry into the pipe line. When this is not done, the use of manual or automatic drips and scrubbers located at strategic points can be satisfactory in some instances, but it is usually difficult to find the proper location. Even when the ideal location is found, conditions of gas flow will usually vary. Changing conditions of supply or market demand may result in higher gas velocities causing the liquids to condense out downstream from the drip or scrubber, thereby eliminating their effectiveness. Also, the gas velocity may be decreased, allowing the accumulation of liquids upstream from the scrubber. When this happens, the pressure differential in the pipe line increases until it is sufficiently high to cause the accumulated liquid to "kick over" and move down the line in a slug. Under this condition, the drip or scrubber is overloaded and "carry over" of the liquid occurs, reducing the effectiveness of the scrubber. Many times, with a reduction in gas velocity, the liquid accumulation may cause sufficient pressure buildup upstream to require partial or complete shutting down of the pipe line for manual draining at low points. Where liquid removal by this method is used, considerable loss is sustained by flashing to atmospheric pressure and subsequent weathering. Even so, sufficient liquid usually remains to justify saving, which requires facilities for storage and hauling the liquid by truck from isolated locations. Thus it can be seen that trapping of condensed liquid hydrocarbons from a gas pipe line is somewhat of a "hit-and-miss" proposition.

In order to show how serious this may become, reference is made to the pipe line map of the Mountain Fuel Supply Company (Figure 1). Gas deliveries into the Salt Lake Valley were started in 1929 with the East Hiawatha field as the upstream terminus of the pipe line. There are no main line compressor stations. Necessary operating pressures are supplied directly by high-pressure wells or field compressor stations. Present operating pressures are 600 pounds per square inch at the Powder Wash and Clay Basin fields with a constant pressure of 415 psi at Green River. The ten-inch line to the Clay Basin field was constructed in 1937, and the eight-inch line to the Powder Wash field in 1941. Dehydration facilities were installed at East Hiawatha and Clay Basin in 1938.

In the beginning, line capacities were well above actual sales and the small amounts of liquid hydrocarbons that accumulated did not cause many operating difficulties. About the time the pipe line was constructed to Powder Wash, gas sales had increased to such an extent that serious operating difficulties were experienced in the 16-inch line from East Hiawatha to point (1) and also between points (2) and (3). Before the accumulated liquid moved beyond point (1), the pipe line pressure at East Hiawatha

UNIVERSITY OF MICHIGAN LIBRARIES

would increase well above the operating pressure of the dehydration plant in this field. When this occurred, the flowing gas volumes were reduced to a minimum and draining of the line was begun by the use of "stingers" introduced under pressure into the pipe line at low spots. The normal pressure drop on the 16-inch line from East Hiawatha to point (2) is eight psi. Just prior to the last draining of this line, the pressure drop had increased to 92 psi. Over a period of four days, 20,000 gallons of gasoline was drained from this line after which the pressure drop was back to normal. The 16-inch line between points (2) and (3) also had to be drained manually. This resulted from liquids which condensed in the ten-inch line from Clay Basin but were swept into the 16-inch line because of high velocities in the Clay Basin line. A gas scrubber installed on the ten-inch line at point (2) removes enough of the liquid at this point to eliminate the necessity for draining the 16-inch line between points (2) and (3). This line has difference in elevation over its route of 1614 feet and experience has shown that if the gas volume from this field drops below 25,000 Mcf per day, liquid will accumulate in the ten-inch line.

Liquid Accumulation Problem

When the volume is increased, the line is swept clean which results in some carry over of liquid at the scrubber. Under the conditions of pressure and temperature on this line, this volume is equivalent to a velocity of 925 feet per minute. Liquid accumulation in the eight-inch line from Powder Wash to East Hiawatha became so serious that this line had to be taken completely out of service about once each month. Inasmuch as liquid accumulations occur in the winter when pipe line volumes are at their peak, the seriousness of this problem can be readily seen.

The only positive method for entirely eliminating the condensing of hydrocarbon liquids in gas transmission lines is to process the gas to a hydrocarbon dewpoint below the expected minimum ground temperature in the pipe line system before the gas enters the transmission line. This is normally accomplished in some type of gasoline plant. Advantages of this type of processing are well known and will give adequate hydrocarbon dewpoint control under any conditions of gas transmission. However, in fields where gas reserves are small or indefinite and gasoline content of the gas is low, the investment required in a gasoline plant is not justified if some other means of hydrocarbon dewpoint control can be used. Since temperature reduction of the raw gas is the thing which causes the progressive accumulation of the hydrocarbon liquids in gas transmission lines, controlled artificial cooling of the gas and low temperature liquid separation at a central point should solve this problem.

With this in mind, Mountain Fuel Supply constructed a gas refrigeration plant in the Powder Wash field in 1946 to determine if a plant of this type would be practical. Gas refrigeration must of course be preceded by dehydration of the gas for water removal to preclude the formation of hydrates in the gas as it passes through the refrigeration plant. The Powder Wash gas refrigeration and dehydration plants were built in conjunction and located in the same building, consequently the flow diagram is more difficult to follow since it includes the dehydration cycle (Figure 2). A description of the refrigeration process will be given later covering a plant recently completed. Briefly, the Powder Wash gas refrigeration plant was designed to cool 15,000 Mcf of gas per day from 60° F to 20° F with a design pressure of 750 psi. Although 20° F is considerably below the minimum expected ground temperature in this area, it was hoped that the undersaturated gas from the Powder Wash plant would tend to partially "dry up" the pipe line downstream from East Hiawatha. Since the completion of this plant, the eight-inch pipe line from Powder Wash to East Hiawatha has never been out of service. During its period of operation, 27,600 barrels of weathered gasoline has been recovered. Although no provisions were made for stabilization of the raw gasoline, which is flashed to atmospheric storage, additional wells have accounted for a much richer gas and recoveries at the present time indicate that stabilization must be given serious consideration.

The results obtained from the Powder Wash plant and the complete lack of success in trapping liquids out of the 16-inch line between East Hiawatha and point (1) seemed to justify a gas refrigeration plant in the East Hiawatha field. Inasmuch as dehydration facilities were in operation in this field, the gas refrigeration plant was all that was required.

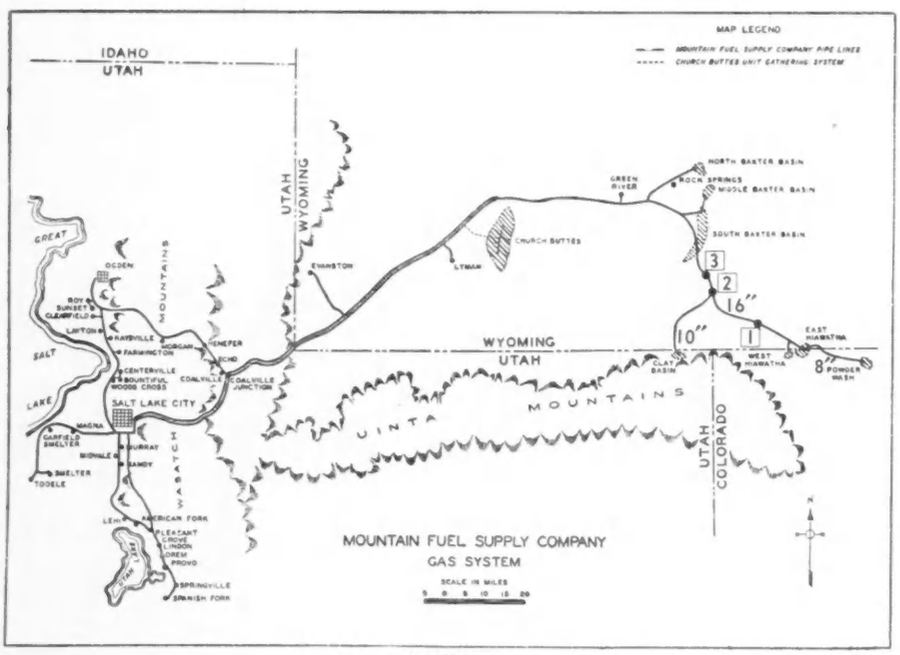


FIGURE 1

East Hiawatha Plant

The East Hiawatha gas refrigeration plant was designed to cool 15,000 Mcf of natural gas per day from 60° F to 25° F and remove the condensed hydrocarbon liquids from the gas stream. Operating pressure is 500 psi. Following the gas cycle, the low-water high-hydrocarbon dewpoint gas enters a shell and tube gas to gas exchanger where it is cooled to 40° F, thence to the gas chiller which is another shell and tube exchanger with the gas in the tubes and the refrigerant in the shell. In this vessel the gas is cooled to 25° F and passes to a gas scrubber where the free hydrocarbon liquids are removed and flow to storage. The low-

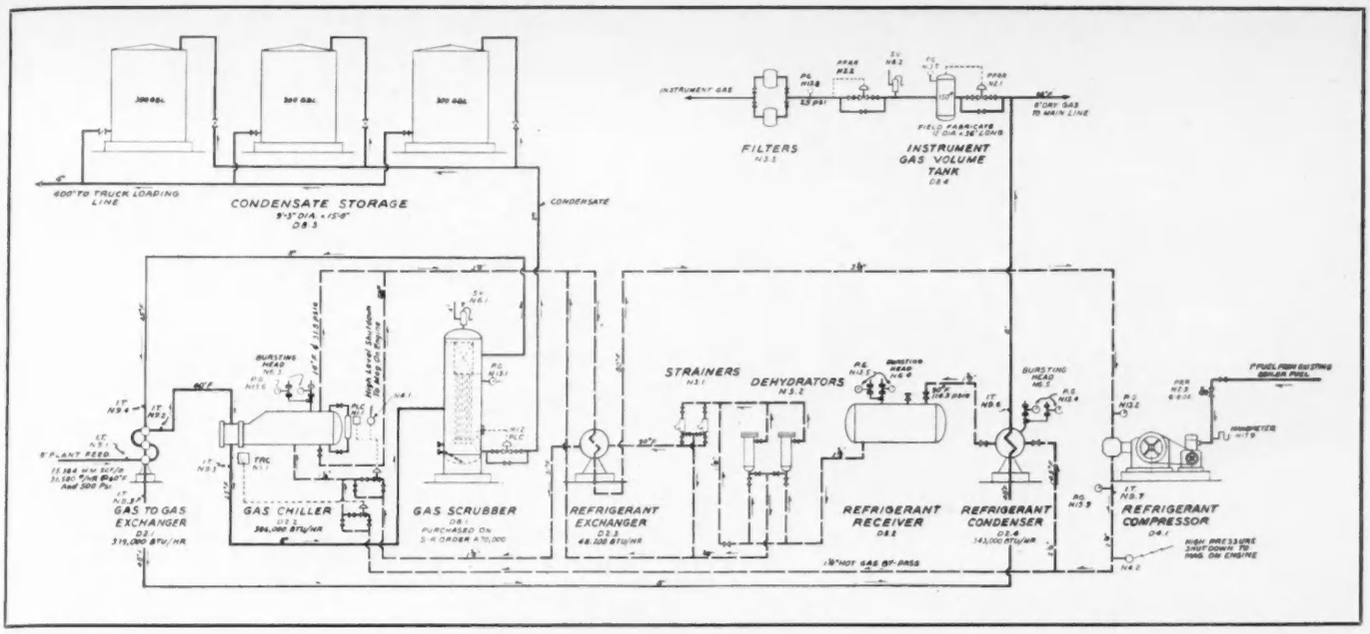


FIGURE 2

water low-hydrocarbon dewpoint gas leaves the top of the scrubber and is exchanged against the raw incoming gas. Through this exchange the gas stream is warmed to 48° F and passes to a shell and tube condenser where its temperature is raised to 68° F in condensing hot refrigerant gas. The dry gas then enters the transmission line and so long as it is not cooled below 25° F or compressed above 500 psi no additional hydrocarbon liquids will condense.

Refrigerant

The refrigerant used in this system is "Freon 12" which is the same material used in most ice boxes. It is nonflammable, non-toxic and non-corrosive with respect to most common metals. The saturation pressures corresponding to the temperatures encountered in natural gas cooling are not extremely high; therefore, the refrigeration equipment can be of light construction. All piping in the refrigerant system is copper with silver soldered joints. Copper piping is used to eliminate the scale prevalent when steel pipe is used and also to give a leakproof system as Freon is very difficult to hold. Approximately 4500 pounds of refrigerant is required for this system.

The Freon compressor has a capacity of 37 tons of refrigeration at 660 revolutions per minute. The machine requires 49.6 brake horsepower which is supplied through a V-belt drive from an internal combustion engine rated at 100 bhp at 900 rpm. Following through the refrigerant cycle, Freon is compressed from 20 psi and 80° F to 105 psi and 145° F and passes to the shell of the refrigerant condenser. In this vessel, the Freon gas is condensed by the 48° F natural gas leaving the plant. The refrigerant flows to the receiver at 90° F and 105 psi. The receiver is a volume tank of sufficient capacity to hold the entire Freon charge should it be necessary to make repairs to the equipment in the refrigerant cycle.

The liquid then passes through a small dehydrator and strainer for removal of any water or foreign material. The dehydrator is necessary to remove small quantities of water that may accumulate from condensation of moisture from the air during the initial installation, or if the refrigerant system is opened to the atmosphere. In the refrigerant exchanger, the 90° F refrigerant is cooled to 51° F by an exchange with the cold Freon gas from the chiller. The liquid then passes through a throttling valve at which point the pressure is reduced to 20 psi and the temperature to 14° F. The cold liquid enters the bottom of the chiller where an external level controller maintains a constant liquid level by actuating the throttling valve.

The liquid Freon is vaporized in the chiller as it absorbs heat from the gas stream. As the natural gas flow increases, the Freon liquid vaporizes at a greater rate and the throttle valve opens to admit more liquid to the chiller. As the natural gas flow decreases the throttle valve closes to prevent the level from rising. The automatic throttle valve is not flexible enough to maintain the gas temperature constant at 25° F under varying load conditions. A temperature controller is located in the natural gas stream at the outlet side of the chiller which controls the hot Freon bypass valve. In the event the gas flow decreases to a point where the throttle valve is closed and the evaporation rate is still enough to cause the natural gas to drop below 25° F, the bypass valve opens adding hot Freon from the compressor discharge line directly into the chiller. This hot Freon adds the heat necessary to keep the refrigerant evaporating at a high enough rate to stop the liquid level from rising in the chiller. In actual operation, the automatic throttle valve and the hot Freon bypass valve work continuously to keep the natural gas temperature constant. Freon gas at 14° F and 20 psi leaves the top of the chiller, passes through the refrigerant exchanger and thence to the suction of the compressor. Should the level in the chiller rise too high, a mercury tilt switch will shut down the compressor engine. Also, a high-pressure shutdown is provided if the compressor discharge approaches the working pressure of the refrigerant system.

All cold lines and vessels are insulated with 1½ inch cork and finished with one-half inch of insulating cement. Vessels and equipment exposed to the weather have an additional covering of wire mesh and three-sixteenths inch weathercoat.

All the equipment with the exception of the gas to gas exchanger and refrigerant condenser is located in an 18 x 32 foot steel frame corrugated iron building. The roof and sidewalls carry one-inch insulation covered with 24-gauge galvanized flat sheets.

UNIVERSITY OF MICHIGAN LIBRARIES

INSPECTION OF *Pipe Coating*

By
MARSHALL E. PARKER
Consulting Engineer, Houston

DEFINING THE duties and scope of the duties of the pipe line coating inspector in more detail than possible in the contract covering such services, the author emphasizes the need for "informal" contact between inspector and contractor in order to obtain best results, and lists for guidance in training inspectors sets of check lists to be used in yard or spread inspection of pipe and its protective coatings.

ONE of the key processes which affect the subsequent corrosion history of a pipe line is that of applying the coating and wrapping materials, and then getting the coated pipe lowered and covered with a minimum of damage to the coating. A central figure in the successful execution of this process is the coating inspector who, with his assistants, represents the interests of the company in overseeing the work of the contractor, to the end that the specifications of the contract are properly carried out. It is not within the inspector's province to specify either materials or methods, and yet, as will be seen, he frequently must do just that in order to carry out his duties.

The relationship between company and contractor is a formal one, and is established in detail in the contract. The relationship between their representatives, the inspector and the foreman, is much more personal and informal, and is established almost wholly by the interaction of their personalities. The primary duty of the inspector, to see that his company receives the kind of job called for in the contract, is not at all inconsistent with the intention of the contractor to make a profit. The inspector who considers that his job is that of thwarting the efforts of the contractor to cheat on the job is throwing out a challenge that is very likely to be accepted. On the other hand, the inspector who considers that both he and the contractor are interested in building a good pipe line is much more likely to find willing compliance to the measures he demands. Still better, if the inspector can help the contractor to cope with the difficulties which arise without undue loss of profit or injury to the job, compliance will be more than willing.

The coating inspector's domain of authority includes the preparation of the pipe surface, the application in the correct manner of the proper quantity of the prescribed materials, and the handling of the coated pipe subsequent to these operations, up to and including the backfilling of the trench. He must also supervise the correction of the defective areas discovered, and should advise on the correction of any technique which is visibly affecting the quality of the coating, or which is known from experience to be injurious. Included in the proper application of the materials is their proper handling in storage and in transit.

Types of Coating Operations

Two general types of coating operation are in common use. They are yard coating, in which joints of pipe (from 20 to 40 feet long) are coated in stationary machines and then hauled to the line for welding, and over-the-ditch coating with a travel-

WHAT has this Diesel got...?

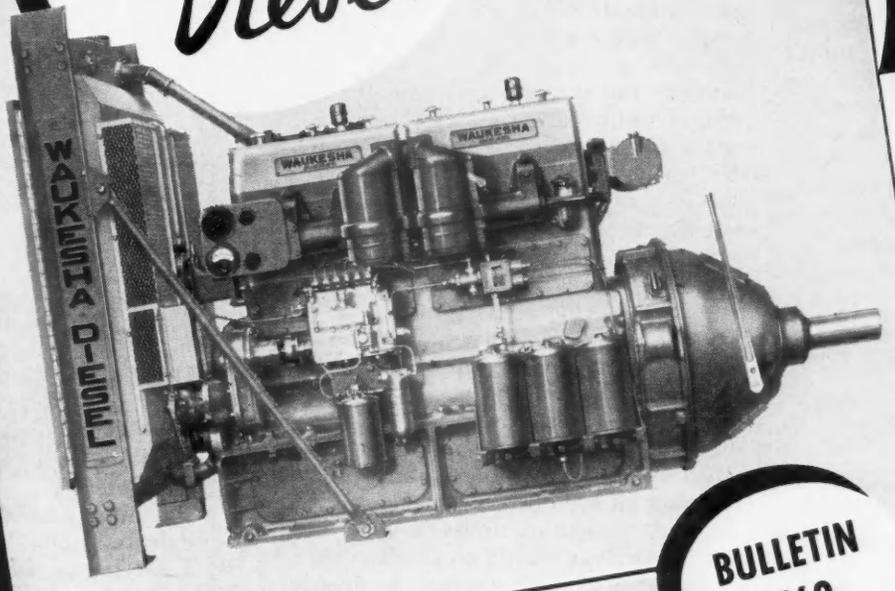
WAUKESHA

MOGUL SIX
POWER
UNIT

6-NKDU
Diesel

PLENTY!

BULLETIN 1569
WILL TELL YOU



BULLETIN
1569

WAUKESHA MOTOR COMPANY • WAUKESHA, WIS.
Eastern Sales Office: Eight W. 40th St., New York 18, N. Y.
Mid-Continent Office: 703 S. Wheeling St., Tulsa 4, Okla.
Pacific Coast Office: 4927 Pacific Blvd., Los Angeles 58, Calif.

● High continuous net output—201 hp continuously at 1050 rpm—that's with all standard power unit accessories. And momentary overload is 272 hp at 1200 rpm. Waukesha's new Mogul Six is a full Diesel, four-cycle, solid injection. Six cylinders, 7-in. bore, 8¼-in. stroke, 1905 cu. in. displacement. Its unique patented combustion chamber cannot be had in any other American Diesel engine! That means smooth, clean, shock-free operation with high fuel economy. You can change over to natural gas, or vice versa, right in the field (there's a quick conversion kit for this). This Diesel unit has all "top drawer" mechanical features—lots of 'em—all interesting. New Bulletin 1569 tells you. Send for one. 110

WAUKESHA
MOTOR COMPANY
WAUKESHA, WISCONSIN
NEW YORK TULSA LOS ANGELES

UNIVERSITY OF MICHIGAN LIBRARIES

ing machine, after the line has been welded into a continuous length. The first method involves considerably more handling of the coated pipe, and much of this handling may be out of the sight of the inspector, with attendant possibilities of damage to the coating. It also involves some field coating at the welded joints, and the relatively smaller amount of this work, as compared to the field work on an over-the ditch job, may lead to poor workmanship if the inspector is not alert. Hand coating of the joints is, indeed, the greatest weakness of yard coating, and may in many cases overcome the advantages gained by the use of stationary equipment under shelter. There is always a greater temptation to continue work under unfavorable weather conditions and to skimp (or even to omit completely) the coating of joints in difficult positions.

Mill coating, in permanent establishments which may be hundreds of miles from the line, will not be discussed in detail here, because it is not often witnessed by company inspectors except on major projects, and the men who perform this inspection will not usually require much instruction in the art. Neither will this article discuss separately the application of special coatings of unusual thickness or density, since these materials involve application techniques and specifications peculiar to themselves. The inspector who has to deal with these is advised to obtain and be ruled by the manufacturer's recommendations.

Materials Used

Five types of materials will be discussed: primers, enamels, felts, glass reinforcements and outer wraps, and temporary outer wraps.

PRIMERS. The primer used with pipe line enamel is a solution in a suitable solvent of material which is essentially the same as the enamel. Storage of this material—usually in 55 gallon drums—offers no particular problems. Care should be taken to avoid contamination, and drums should always be tightly sealed, since evaporation of the volatile solvent will thicken the primer and interfere with its proper application. The usual precautions applicable to the handling of inflammable volatile liquids should be observed.

An auxiliary material supplied with the primer is the thinner, which is merely the solvent used in compounding the primer. Its storage and handling is similar in all respects to that of the primer.

ENAMELS. Pipe line enamels are either of petroleum asphalt or, more commonly, of coal-tar base. To this bituminous material has been added an inert mineral filler in the form of a suspension. Most enamels are shipped in drums of thin metal which are cut open in order to remove the contents. Outdoor storage is entirely satisfactory for the packaged material, but once it has been opened and cut up for melting it must be protected from contamination with dirt, sticks, and trash. In general, the material should be cut up as used, so that no great quantity is allowed to accumulate at any one time.

The fluxing oil which may be used with coal-tar enamel to prevent undue brittleness at very low temperatures is handled and stored in drums very much as primer and primer thinner.

FELT. Felt is the third member of the trio of materials which must be consistent; that is, all three must be either asphalt or coal-tar; these two basically different materials are not mutually miscible or soluble, and cannot be used together satisfactorily. In the case of primer and enamel (including thinner and flux) the same manufacturer usually furnishes both for a given job, and no qualms need be felt as to their compatibility. In the case of felt, however, the inspector should quietly assume the responsibility, which properly belongs elsewhere, of verifying that the proper saturant is being used. This is merely one of many responsibilities which the inspector should assume, although they are properly delegated to someone else. As long as all is well, no harm is done and no friction developed by his quietly and unobtrusively keeping an eye open; when, however, he finds something amiss, a word in the proper ear should correct the situation before any damage is done, and without necessarily creating any difficulty.

Unlike the materials previously discussed, pipe line felt cannot be stored in the open. It must be protected from all moisture and dampness. Felt should never be stacked on a bare concrete floor; the bottom layer will absorb enough moisture from an apparently dry floor to cause a great deal of trouble later. Unless the floor is very damp, however, a single layer of planks will be adequate protection. This tendency to absorb moisture also makes it imperative that only small quantities of felt be removed from the warehouse at one time, and even when this is limited to a daily supply, adequate facilities for its protection must be provided at the point of use.

GLASS MATERIALS. Porous mats of glass fibers are in common use as coating reinforcement; more recently, impregnated glass outer wrap has been developed to be used in the same way as felt. This material will also absorb moisture, and should be protected in the same way as felt.

TEMPORARY OUTER WRAPS. When coated pipe has to be exposed to the weather for some time before being covered, it is usual to apply an outer wrap of kraft paper or an outer coating of whitewash, in order to reduce the temperature which otherwise would be reached in sunlight. This temporary wrap also serves the incidental purpose of making any abrasion damage very obvious, so that visual inspection may be directed to any spots so indicated. Upon the burial of the line, this material has completely performed its function; any damage it may receive immediately prior to burial is of no importance whatever.

Kraft paper should be stored and handled under the same rules as felt, and for the same reasons—to avoid the absorption of water.

Processes to be Inspected

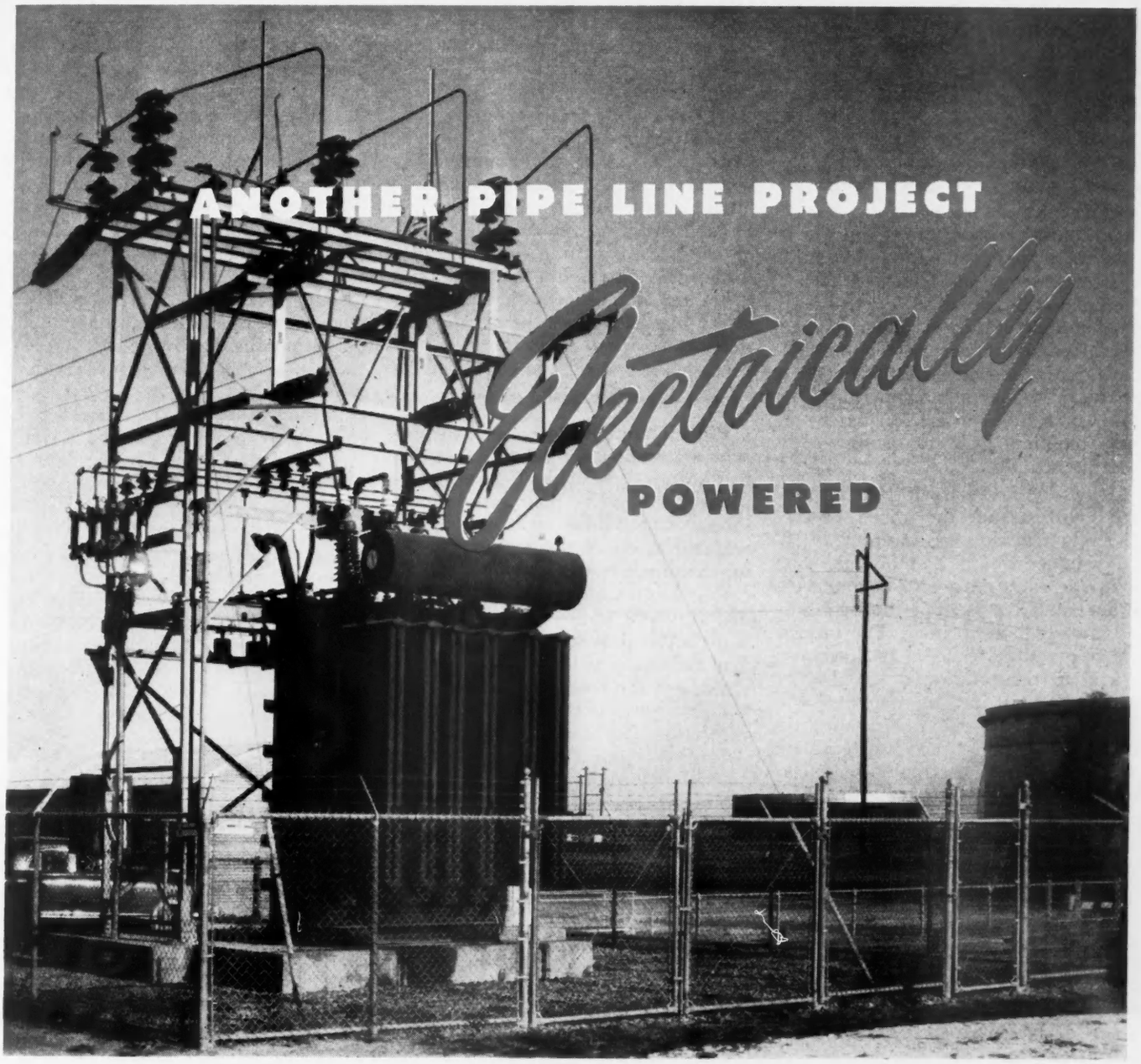
The processes which are the primary concern of the coating inspector are, in approximately chronological order, as follows:

(1) Pipe handling, cleaning, and priming.
(2) Application of enamel.
(3) Application of felt and reinforcement.
(4) Handling of coated pipe.
(5) Coating of field joints (when pipe is yard coated.)
(6) Coating inspection with holiday detector.
(7) Patching of holidays and other defects.
(8) Lowering-in and backfilling.

There is considerable chronological overlapping of these processes; sometimes all of them are proceeding simultaneously all along the line. At such times the inspector may find his forces severely taxed in their efforts at complete coverage, and frequently choice must be made, in which case it is usually better to be sure that the last stages, particularly (6) and (7) are adequately supervised.

Pipe Handling, Cleaning, Priming

Proper handling of the pipe before the coating operation will greatly facilitate the correct execution of this process. The less mud and dirt on the pipe the easier for the cleaning machine to perform its function correctly. It is not the proper function of the cleaning machine to remove



More and more pipe lines are using low-cost Purchased Electric Power in their pumping stations. Your power company is better equipped to give you better service at a lower cost than ever before! ECONOMICAL? *PEP cuts down installation, operating, maintenance, and labor costs! CONVENIENT? With *PEP you have constant, dependable service, automatic controls, a smoother and more satisfactory, trouble-free operation. Call the Power Engineer of your Utility Electric Company—he will give you complete details on *PEP.

*PEP – Purchased Electric Power

Petroleum Electric Power Association

ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

CALL YOUR NEAREST ELECTRIC SERVICE COMPANY FOR MORE FACTS

UNIVERSITY OF MICHIGAN LIBRARIES

dried mud, and to attempt to so use it will result in rapid dulling of the knives and very frequent replacement. Of course, in over-the-ditch coating, a certain amount of this is perhaps inevitable, but it should certainly be kept to a minimum, even should this require considerable hand cleaning.

Where yard coating is employed, the coating inspector, being frequently the only company representative present, should not hesitate to include in his domain the control over the handling of pipe in such a manner as to avoid damage to the beveled ends or threads, and all kinds of mechanical damage in general. The same is true but to a lesser extent of pipe handling prior to coating over the ditch.

It will be necessary for the inspector to insist that the knives of the cleaning machine are replaced often enough to secure a thorough job. Worn brushes must also be replaced often enough to secure a thorough job of spreading the primer. The proper ratio of pipe traverse or machine travel to the rotation of the knives is usually built into the machine, but occasionally one may be encountered which has been altered in an attempt to speed up the work, usually at the expense of thoroughness.

Above all, the pipe must be dry when primed. This is an absolute must, for moisture on the pipe completely nullifies the entire operation. This means that on many days there will be an enforced delay to permit the dew to evaporate from the pipe. Such delays are irritating and costly, but the only acceptable substitute is torch drying, which is apt to be even more expensive. Outdoor priming in the lightest rain is completely out of the question and must not be tolerated.

The rate of primer feed must be controlled so as to give adequate coverage. A slight excess is preferred, so that there is a very little drip from the pipe. Hand priming of occasional skips is permissible, provided it is well brushed, but the basic method here is to seek out and correct the cause of the skips. The dilution of normal primer with large quantities of thinner in order to shorten the drying time is not to be permitted. Slight dilution in very cold weather is allowable, and primer which has been thickened by evaporation (which should be avoided is possible) may be corrected by the addition of thinner. The manufacturer's recommendations are a safe guide in the use of thinner for the above purposes.

Second-hand pipe with its rough surface, adherent corrosion products, and pits filled with moisture-holding matter, is particularly difficult to clean and prime correctly. Sand- or grit-blasting is effective, but expensive. Mudd has described a process which employs a preliminary pass with a cleaning machine using diluted primer, followed (after an interval for drying) by a second pass of the cleaning unit using normal primer. The first, dilute solution penetrates the porous corrosion products in the pits and drives the moisture to the surface where it evaporates.

Application of Enamel

Proper handling of enamel to prevent contamination with dirt, sticks, trash, and the like, is of utmost importance. A clean floor or platform should be provided on which to cut the enamel into pieces of suitable size for melting. On the line, such a floor can be improvised from the flattened drums in which the enamel is shipped if no better provision has been made. The melting pots must be thoroughly cleaned of the residue from each melt before a new charge is added. There will always be a certain amount of sediment, separated filler material, and coked enamel which must be removed to prevent contamination of the next charge.

Sufficient time should be allowed to melt the enamel, the object being to avoid as much as possible the local overheating which must accompany rapid melting, with attendant coking and lowering of the quality of the enamel. The final temperature at which the enamel is to be applied should not be exceeded during the melting process—or, at most, the highest permissible application temperature for the particular enamel in use should not be exceeded. This temperature range is determined by the manufacturer's recommendations. The practice of adding unmelted enamel to a pot from which enamel is being used should not be permitted, since this makes the temperature reading taken at any part of the pot meaningless. It is possible that a satisfactory continuous melting technique may be evolved, but with the equipment now in service, batch melting with thorough pot cleanout between batches is the only way to be sure of a good job. Stirring, during the melting period, and particularly during the period of withdrawal from the pot, is necessary in order to avoid the settling out of the mineral filler in the enamel.

The enamel will not bond satisfactorily to the primer unless the latter is "live." There is an interval of time following the application of the primer during which it is too wet—that is, contains too much of the solvent—for successful enameling. This period may range from three hours to perhaps 12, depending largely upon atmospheric temperature and air circulation. Any attempt to apply the enamel during this period will result in the sudden evaporation of the remaining solvent by the hot enamel, forming a multitude of small bubbles whose entrapment in the enamel renders it porous. Following this interval there is a longer period of time during which the primer is in proper condition to receive the enamel, having a mere trace of residual solvent. After this, the primer becomes "dead" and enamel will not bond properly. If the primer is wet or slippery to the touch, it is too green, if it is slightly tacky, it is in good condition; if there is no stickiness when the palm of the hand is pressed firmly on the pipe, the primer is dead, and enamel will not adhere properly. The only remedy for dead primer is a reapplication; the dead coat need not be removed, and somewhat diluted primer is satisfactory for this purpose, at a considerable saving in drying time.

The inspector should not hesitate to suggest the shutting down of the cleaning and priming operation when it seems to be getting too far ahead of the coating process; compliance to such a suggestion is less expensive to the contractor, and hence more willingly given, than compliance to a demand to reprime pipe. In yard coating operations space limitations will usually prevent the accumulation of too much primed pipe between the cleaning machine and the coating and wrapping equipment, but on the line there is nothing to keep one crew from getting too far ahead of the other, particularly when there is a breakdown or something similar.

Application of Felt

Felt, glass reinforcement, and outer kraft paper wrap are all applied in conjunction with the coating operation, since their successful bonding depends on their being applied while the enamel is still plastic. The glass mat, being porous, disappears into the hot enamel. It is probably not possible to apply it too soon—to have the glass roll too close to the point of application of the enamel, since there will be a layer of enamel cooled almost instantaneously by contact with the relatively cold pipe. The felt, on the other hand, must be applied at a point which is sufficiently remote from the

2 signs of valuable "finds"

What's sweeter music to a "sourdough's" ears than the bray of his burro? Why, it's the clicking of his Geiger Counter telling him uranium's at hand . . . and the louder it clicks the better the lode. That's why prospectors today carry and count on the Geiger to tell them when they've made a VALUABLE "FIND."

You don't need a Geiger Counter to hit the mother-lode in wire rope value. Just look for the HAZARD REEL. It's the sign of a wire rope that users everywhere recognize and rely on for uniformity, longer service, easier handling and utmost dependability. It's the sign of more for your wire rope dollar . . . the sign of a VALUABLE "FIND."

ACCO *In Business for Your Safety*

AMERICAN CHAIN & CABLE
HAZARD WIRE ROPE DIVISION

TRADE MARK

Wilkes-Barre, Pa., Chicago, Denver, Houston, Los Angeles, Odessa, Tex., Pittsburgh, San Francisco, Bridgeport, Conn.

UNIVERSITY OF MICHIGAN LIBRARIES

enamel spout to give the specified thickness of enamel. This distance is not adjustable on the traveling type machine, which means that the coating thickness must be regulated by controlling the temperature of the enamel and its rate of flow.

When the rate of flow and the temperature are correct, there will be a small amount of enamel squeezed out in a continuous strip at the edge of the felt. Excessive squeeze-out is not only wasteful of material, but may be indicative of too high a temperature, with resultant thin coating. Total absence of squeeze-out always raises the question of the completeness of coverage under the felt, where it cannot be seen; besides, the edge of the felt should be attached. Although either of these defects—too thin a coat or incomplete coverage—should be detected later by the holiday detector, any malfunctioning of the equipment should be caught as soon as possible.

The kraft paper, when used, is applied so that the center of the strip falls on the squeeze-out at the edge of the felt. This affords the only bond for the kraft, except the customary dab of enamel at each end.

All of these wrapped materials—glass, felt, and kraft paper—must be applied at the correct tension in order to achieve satisfactory results. Too much tension will tear the material, as will uneven tension. Too little tension causes buckling and failure to bond properly. The braking or restraining device which controls tension usually has to be adjusted by trial, as is also frequently the case with the adjustment which controls the angle of application of the roll, and hence the amount of lap obtained.

When one of these materials breaks, or when a roll is exhausted, it is necessary to interrupt the operation for a few minutes. During this interval, the enamel between the last bonded wrap and the spout will have hardened, and there will be a gap in the bond unless hot enamel is applied by brush or pouring can, just as the normal operation is resumed. In yard coating operations the largest size rolls may be used, and there will be little waste if pieces not long enough to wrap a whole joint are discarded—to be used later in hand patching operations—but in over-the-ditch coating, there must be a stoppage whenever a roll is exhausted.

The yard coating system inevitably involves more handling of coated pipe than the technique of coating on the line. This extra handling, with its attendant danger of damage, together with the necessity of hand-coating the field joints, comprise the offsetting disadvantages of yard coating, as compared to the presumably better job of coating which can be done under the controlled and protected conditions in the yard, and the economies in material handling.

Handling Coated Pipe

The first handling of the freshly coated pipe, when the enamel is still soft and subject to damage by even moderate pressure, is of extreme importance. If all the pipe joints were of equal length, the problem would be simple enough, since all that would be necessary would be to support the joints on the short uncoated portion left at each end for the field welding. Another provision must be made in most cases, as joints of variable length must be handled. A pair of sloping platforms so arranged that the joints roll only on their ends is the best simple solution that seems to have been devised. Elaborate conveyor systems, handling the pipe by the ends until it has cooled sufficiently, are sometimes found in permanent coating plants, but their complexity and cost rule them out for temporary yards.

After a few minutes' cooling on these boards, the coated pipe may be rolled onto padded stringers to await loading into the trucks which will carry it to the line. Enough rack space should be provided to allow for the accumulation of coated pipe between trucks to make stacking unnecessary, if at all possible. Should stacking become necessary, care should be taken that enough stripping is used between layers to avoid high contact pressures. Far more stripping is required than is needed to make pipe rolling easy.

Loading on trucks should be done by some type of boom which handles the pipe by the ends only, and adequate padding should be used on the bolsters, between layers of pipe, and under the chains which bind the load. A frequent cause of damage in this operation is the swinging of one end of a joint against coated pipe already in place on the truck, thereby causing a break in the coating. This can be avoided only by careful handling; careful handling may not be had unless it is insisted upon. All the precautions mentioned in connection with loading are equally applicable to the unloading along the line, with additional care being required by virtue of the fact that the pipe must be laid on the ground. Some effort should be required of the crews to lay the pipe where it is not subject to puncture damage by sharp rocks and the like.

Belt slings should be used in handling the pipe for welding up, since it is impossible to handle it by the ends at this stage. After welding, the line must be supported either on the bare sections at each joint or on well-padded skids. The latter arrangement is more convenient, since then there will be nothing in the way of the coating operation required on the welded joints.

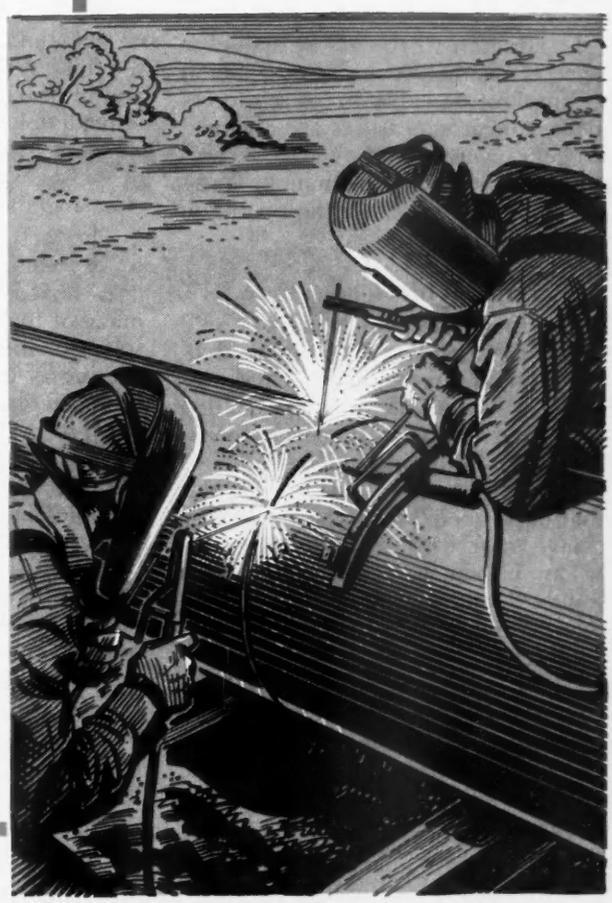
Ordinarily there is very little handling of the pipe after the coating operation when the traveling type equipment is used. The primed pipe usually rests on skids across the ditch, and is picked up by a cradle suspended from a side-boom tractor. Behind the cradle travels the coating and wrapping machine, and the coated pipe is lowered directly into the ditch without further handling. At intervals determined largely by the terrain slack loops are left, to be lowered only after the pipe between them has been backfilled. These must be supported on particularly well-padded skids, because of the relatively great weight resting on them, or, even better, on belt slings suspended from special cradles designed for the purpose. Provision should be made for longitudinal freedom of motion, to prevent cutting of the coating by one edge of the sling. The use of skids should be restricted to the smaller sizes of pipe.

Coating Field Joints

Yard-coated pipe has a small section left uncoated at each end, and after the line is welded, these field joints must then be coated by hand. Strict attention should be paid to the proper cleaning and priming of these joints, and to the proper drying of primer, no less than with the pipe as a whole. Poor work on these sections can largely nullify the effects of an otherwise good job, since they comprise from 2 to 5 percent of the total pipe area. Two men may work out ahead of the coating crew, one cleaning and the other priming. Care should be taken to see that they do not get too far ahead, lest the primer be dead by the time it is coated.

The kraft paper should be torn back or cut off so that the primer can be carried a few inches up onto the coating. Then the enamel should also be carried over the exposed end of the yard coating, so that an overlap of at least two inches is obtained. It is common practice to apply a

Why the *FIRST* names in pipelines depend on the *FIRST** name in line pipe



*** *FIRSTS* by A. O. SMITH • Welded line pipe • Internal expanded pipe • Light wall large diameter pipe • World's largest producer of large diameter welded steel line pipe**

• When it's A. O. Smith Line Pipe — it's round and it lines up for easy welding. Why? Because A. O. Smith's internal expanding process makes sure of that by stressing the pipe beyond its yield point—and when pipe is stressed beyond its yield point by uniform internal expansion it automatically comes out round, straight and consistently of the right diameter. This process produces pipe of high yield strength — lighter, stronger line pipe — without using expensive alloy steel. The result: higher operating pressures at lower cost per mile and weldability without recourse to special welding practices.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝ in. to 36 in. in diameter.

DEPENDABILITY *through* **RESEARCH** *and* **ENGINEERING**

A. O. Smith way 77th ANNIVERSARY 1874 - 1951

A.O.Smith

LINE PIPE • CASING

UNIVERSITY OF MICHIGAN LIBRARIES

somewhat heavier coating on the field joints, because of the difficulty in obtaining accurate control in manual work. A very common offense is the use of enamel which is too cold. The effort to get one more joint coated before taking the bucket back for a refill is responsible for a good deal of poor workmanship.

In addition to the use of a thicker layer of enamel, it is not uncommon to employ an extra glass reinforcement. All such measures are designed to help overcome the lack of uniformity inherent in the manual application as contrasted to the operation of a machine.

Inspection With Holiday Detector

The first thing which must be said about the holiday detector is that, whatever it may be, it is not a device which will infallibly tell good coating from bad coating. It never speaks positively, but only negatively. When it is silent, it does not imply "this coating is good"; but when it speaks, it says "here the coating is not good." It can, of course, be set to too high a standard, and thus be led to condemn coating which is actually satisfactory for the job at hand.

The principle upon which this device operates is that of imposing a high voltage between the pipe itself and an electrode which is moved along the outside of the coating. Any bubble or thin spot in the coating, or any area where the coating is missing, will afford a path for the passage of current; this event will be signalled by the detector, the exact manner of indication varying with different models. Care should be exercised to avoid missing one or more holidays when several are encountered simultaneously.

Obviously, in order to perform its function properly, the device must be given the opportunity to examine the entire surface of the coating—every square inch must be covered. When a wire brush type of electrode is used, this requires extreme care, since accurate centering on the pipe is necessary, and great care must be taken to avoid spreading of the "whiskers" so as to form gaps. If the rolling spring type of electrode is used, there is very little danger of missing any of the coating, so long as the entire length of the pipe is covered—and the easiest way to ensure this is to leave the electrode on the pipe as much as possible. It is possible to traverse many miles of pipe line in one continuous movement when the detector uses a detachable electrode.

It is equally obvious that this inspection should be as nearly as possible the last item before lowering the pipe. Customarily the detector is run behind the coating and wrapping machine, on the pipe which is on its way to the bottom of the ditch. When yard coating is being employed, the detector should be run along with the lowering-in crew, behind the coating of field joints. In either case, all of the holidays found should be marked, and in nearly all cases, can be patched immediately, although it may be necessary to stop the forward progress of the lowering-in if several are found close together.

The fact that the final inspection is to be made just before lowering in does not mean that no use can be made of the holiday detector at other stages of the job. In fact, where yard coating is used, it is important that the detector be run on the pipe in the yard, so that any defects in the operation of the equipment or handling of the pipe may be found as soon as possible, and remedied before large quantities of pipe are improperly coated. If, however, a choice must be made, there is no question that the detector's proper place is at the latest possible stage of the operation.

The details of adjustment and operation of the holiday detector cannot be specified here because of the variation in design among the various types. Even the voltage settings to be used in testing coatings of various types and thicknesses must be left to the recommendations of the manufacturers, as there is no general agreement as to the use of crest or average voltage, or as to which of these two values is indicated on the machine.

It was stated above, and is emphasized here, that the holiday detector will not detect all of the defects which a given coating may possess. Among the more glaring defects which will not be indicated are poor bonding, or even total lack of bond; omission of glass reinforcement; inclusion of sticks or trash (dry); areas where coating is thin or missing, when under buckled coating. It would be possible to apply a coating to pipe which had been neither cleaned nor primed. If this pipe was then handled very gently, so as not to break the coating, it would pass inspection with a holiday detector. The protective value of such a coating would, however, be very slight. Trash or sticks which contain moisture will form bubbles when included in enamel, and these bubbles will be revealed. Dry trash, however, may easily escape detection; after burial such foreign matter will absorb moisture and thus expose the pipe to corrosive attack. A buckled place in the coating will separate the electrode from the pipe surface a sufficient distance to prevent the passage of a spark, whether the coating at that point is good, poor, or absent. These and other similar examples serve to illustrate the principle that the holiday detector is not a self-sufficient inspector of pipe coating, but an important auxiliary to intelligent inspection.

Patching Holidays

Each visible defect or indicated holiday should be marked by the inspector as soon as it is discovered by circling it with chalk or lumber crayon. From the circle a line should be drawn up to the top center of the pipe. When yard-coated pipe is being inspected on the rack, this line should completely encircle the pipe to avoid overlooking smaller marks. Immediately behind the holiday detector comes the patching crew; on an over-the-ditch job this crew has to work fast in order to avoid delays.

First step in the repair consists of cutting away the coating around the holiday. This should always be done with a knife or similar instrument; under no circumstances should the coating be broken off by hammering. The bared spot should then be daubed with a generous quantity of hot enamel, and covered with a piece of felt. On a small spot this may be merely pasted on; on larger defects, the felt should be wrapped around the pipe and sealed with hot enamel. These patches are usually made somewhat thicker than the regular coat, for reasons similar to those cited above in the discussion of the coating of field joints.

Extensive areas which have been mechanically damaged should be cleaned off completely and coated like field joints. These should be discovered and repaired before the actual lowering-in time, since they may require the complete cleaning-priming-coating process, rather than the more rapid patching employed with smaller defects.

Lowering-in and Backfilling

The ditch should be inspected well ahead of the lowering-in process, and all sharp objects likely to damage the coating removed. Very rocky ditch should have a soil pad placed under the pipe; if, however, this protection is not called for in the specifications, it may not be possible for the coating inspector to require it of the contractor. Broken milk bottles, tin cans, welding rod stubs, and other trash, however, can and must be removed

INTERNATIONAL

INTERNATIONAL HARVESTER

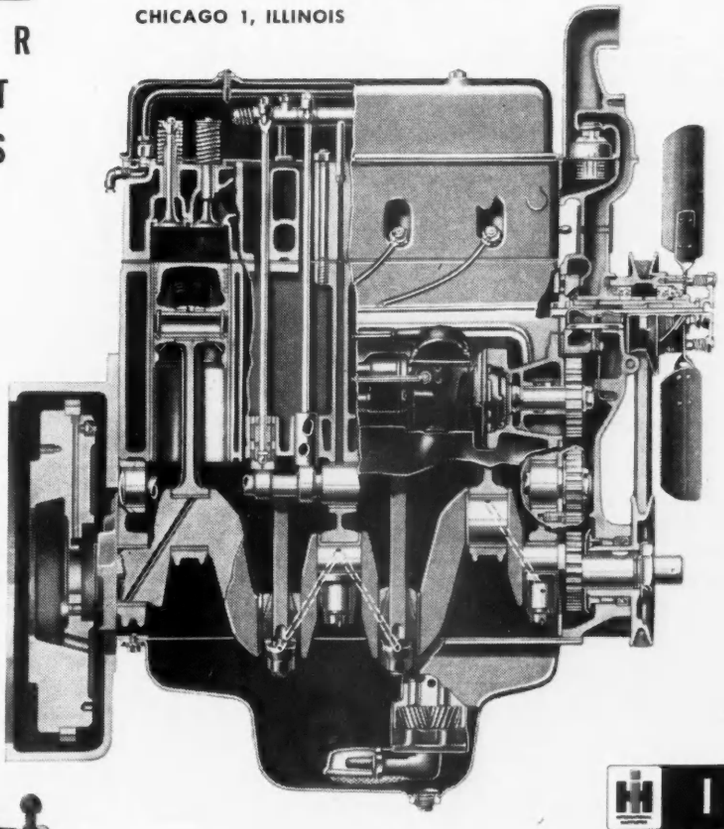
POWER THAT PAYS

Pat Hand

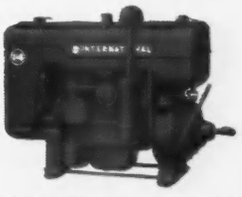
5 sizes of power
5 big reasons why

ADAPTABILITY—wide range of use, easy installation
ENDURANCE—proved in the field by thousands of users
ECONOMY—low-cost repairs and maintenance
SERVICE FACILITIES—everywhere in the oil fields
REPUTATION—all the backing of the International name

INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS

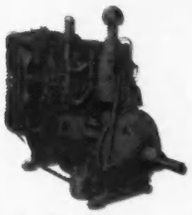


U-6, 37.5 A.P.I. max. hp at 1500 rpm



U-4, 28.5 A.P.I. max. hp at 1800 rpm

U-1, 10.5 A.P.I. max. hp at 1800 rpm



U-9, 49 A.P.I. max. hp at 1500 rpm

U-2A, 21.8 A.P.I. max. hp at 1800 rpm

INTERNATIONAL

INTERNATIONAL HARVESTER COMPANY
P. O. Box 7333, Chicago 80, Ill.

Please send me a copy of your catalog, A-384-NN International Oil Field Pumping Engines.

Name _____

Address _____

City _____ Zone ____ State _____

UNIVERSITY OF MICHIGAN LIBRARIES

from the ditch. It may even be possible, although it will probably be difficult, to break the welders of the habit of discarding their rod stubs in the ditch.

The lowering-in of pipe coated over the ditch follows immediately the coating and wrapping operations, with no intervening handling of the pipe, except for the slack loops, which are left up on skids to be lowered later in the same manner as yard-coated pipe. As each section is picked up (using a belt sling) the holiday detector will be run past the point at which the skid was placed; this place should always be examined, since it is possible for the edge of a skid to cut completely through the coating, yet raise a pair of ridges over which the electrode may pass without indicating a holiday. When the electrode has been run almost to the supporting sling, the pipe is lowered and the sling released. Then when the next section is lifted from the skid, it will be possible to run the detector over it, without ever having removed the electrode from the pipe; in this way the point of support by the sling is also subjected to examination.

Backfilling should be done, insofar as possible, in such a way as to avoid damage to the coating. Where the backfill contains rocks, hard clods, or frozen earth, a pad of soil should be placed on the pipe first. If this cannot be insisted upon, everything possible should be done to minimize the damage by hand shoveling the first soil placed, or at least by having the bulldozer take a light initial cut before trying to shove the whole backfill in with one push.

One point to watch closely is the lowering of slack loops. Ofter a little too much slack is left, and the loop refuses to go down by its own weight. Impatient foremen will sometimes stack skids on the pipe and push it down with a tractor, or get it down in some other violent way, if permitted to do so. Since this will almost always damage the coating severely (it may even damage the pipe), it should never be permitted. In a really obstinate case, the only permissible remedy may be the cutting out of the ditch on one side, by hand, to let the loop down of its own weight. This is slow and costly, but if it is required in order to avert damage, it must be insisted upon.

Not all phases of pipe line coating inspection have been covered. Nor have all of the problems which will be encountered been even mentioned, much less discussed. Perhaps the most important single omission has been the problem of casings; but most of the unsatisfactory conditions in this connection can be remedied only at an earlier stage; namely, in the original specifications. The inspector cannot go very far beyond what is required by the letter of the contract. He can fill in minor omissions; he can insist on "good practice" where the contract is not specific; but he cannot elevate the standards to any major extent, nor revise the plans and specifications. How well he succeeds in obtaining compliance to the practices enumerated in the contract or enunciated by the standards of good practice may depend not so much on how much he knows about how the job should be done as upon how much he knows about getting along with people.

Coating Inspector's Check List Yard-Coated Pipe

Materials, handling and storage

(1) Proper quantities of enamel, primer, felt, reinforcement, and kraft paper on hand. Thinner and flux, if needed.
(2) Primer and felt of correct type for use with enamel furnished.
(3) Wrapping materials stored in dry place, off the floor.
(4) Clean, protected cutting floor for enamel.

Equipment

(5) Spare knives for cleaning machine.
(6) Adequate rack space for primed pipe.
(7) Adequate kettle capacity, to lessen the inclination toward too rapid melting.
(8) Cooling boards for freshly coated pipe.
(9) Storage racks for coated pipe—sufficient space to avoid need for stacking.

Cleaning and priming operation

(10) Knives changed as often as needed.
(11) Primer flow regulated; thinner not used to hasten drying.
(12) Brushes in good condition.
(13) Primer supply drums kept closed.

Coating and wrapping operation

(14) Primer in proper condition to receive enamel.
(15) Enamel used from completely melted kettle.
(16) Kettle thoroughly cleaned between melts.
(17) Correct application temperature.
(18) Flow correctly adjusted.
(19) Proper squeeze-out being obtained.
(20) Specified lap on wrapping materials.
(21) Specified thickness of enamel (check frequently.)
(22) Hot enamel used to bond end of new roll or after break.
(23) Enamel being cleaned off ends of joints correct distance.
(24) Holiday detector.
(25) Holidays correctly patched.

Pipe stringing

(26) Joints lifted by ends in loading.
(27) Truck bolsters padded.
(28) Load secured with padded booms.
(29) Pipe unloaded by lifting (do not permit rolling off truck.)
(30) Pipe carefully placed; leave clearance for vehicles.

Welding

(31) Pipe handling by belt slings.
(32) Pipe supported on padded skids or belt slings.

Coating of field joints

(33) Ends of yard coating beveled.
(34) Welds cleaned and primed; allow sufficient time to dry.
(35) Correct enamel temperature (beware of cold enamel.)
(36) Joint overlapped onto yard coating.
(37) Enamel melting and handling procedure satisfactory.
(38) Adequate protection of wrapping materials from moisture.

Lowering-in

(39) Pipe handled with belt slings.
(40) Holiday detector run on every foot of pipe, behind lowering tractor.
(41) Skid marks inspected for cutting.
(42) Holidays properly patched; delay lowering if necessary.
(43) Slack loops left on well-padded skids.

Backfilling

(44) Use soil to protect pipe from rocks and clods.
(45) Check skid marks on slack loops.
(46) Do not permit rough handling of slack loops.

General

(47) Meet the contractor half-way; make no unreasonable demands, and compliance with the reasonable requirements will be easier.

Coating Inspector's Check List Over-the-Ditch Coating

Materials, handling and storage

(1) Proper quantities of enamel, primer, felt, reinforcement, and, if used, thinner and flux.
(2) Primer and felt of correct type for use with enamel furnished.
(3) Wrapping materials stored in dry place, off the floor.
(4) Dry portable storage for wrapping materials.
(5) Two or more kettles for enamel melting.
(6) Clean cutting floor for enamel.

Cleaning and priming operation

(7) Knives changed often enough on cleaning machine.
(8) Primer feed correctly regulated.
(9) Brushes in good condition.
(10) Primer drums kept properly closed.

Coating and wrapping operation

(11) Primer far enough ahead of coating machine to secure proper drying; "dead" primer re-applied.
(12) Enamel applied at correct temperature.
(13) Proper flow maintained.
(14) Correct squeeze-out obtained.
(15) Specified lap on felt and reinforcement.
(16) Specified enamel thickness (check frequently.)
(17) Wrapper bonded with hot enamel after each stop.
(18) Holiday detector run close behind wrapping machine.
(19) Holidays properly patched (stop forward progress if necessary.)
(20) Slack loops set on well-padded skids or slings.

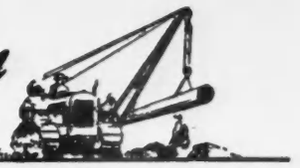
Lowering-in and backfilling

(21) Skid marks checked at slack loops.
(22) Slack loops lowered without rough handling.
(23) Pipe padded with soil where backfill contains rocks or clods.

General

(24) Meet the contractor half-way; make no unreasonable demands, and compliance with reasonable requirements will be easier.

PIPE LINE *Construction*



By SYLVIA LILLIE, Staff Writer

Projects Announced and Contracts Awarded

Crude Oil Lines

Alberta Natural Gas Company, subsidiary of Northwest Natural Gas Company, applied to the Dominion Board of Transport Commissioners for permission to build a 950-mile, 16-inch line from Alberta fields near Edmonton into the U. S. at Kingsgate, B. C., across Washington state to a terminal at Vancouver, B. C. This is the route of a natural gas line proposed by Northwest Natural. Crude line would serve existing and proposed refineries in Washton and Vancouver.

Platte Pipe Line Company awarded contracts for building its 1078-mile line from Worland, Wyo., to Wood River, Ill. R. H. Fulton & Company, Lubbock, Texas, will build 573 miles of 16- and 20-inch from Worland to Holdrege, Neb.; Bishop & Lock Construction Company, Dallas, has the contract for 142 miles of 20-inch from Holdrege to Marysville, Kansas; Rumsey Brothers Pipe Line Construction Company, Houston, will build 100 miles of 20-inch from Marysville to St. Joseph, Mo.; O. R. Burden Construction Corporation, Tulsa, will build 280 miles of 20-inch from St. Joseph to Wood River.

Products Lines

California Texas Oil Company plans a 96-mile eight-inch line from its refinery near Milan to a terminal on the Mediterranean.

Great Lakes Pipe Line Company will build in the Spring 75 miles of eight-inch paralleling the existing six-inch line between Des Moines and Iowa City, Iowa.

Humble Oil & Refining Company is building a 19-mile, four-inch line from its New London gasoline plant in Rusk County to Texas Eastman Company's chemical plant in Harrison County, Texas.

United States Pipe Line Company announced a change of route for its proposed 965-mile line from the Houston-Beaumont refining area. Instead of terminating at St. Louis and Chicago, as originally planned, the line would run to Cincinnati and Dayton.

Natural Gas Lines

Cities Service Gas Company announced an expansion program for 1951 which includes more than 700 miles of gathering system in the Hugoton gas field, and new compressor stations at Greensburg, Kansas, Welch, Okla., and Pierce City, Mo. It is also developing new storage fields near Topeka and Colony, Kansas.

Cities Service Gas Company applied to FPC for permission to lay 29 miles of 16-inch from Wichita to Hesston, Kansas, and 16 miles of ten-inch from Vilas to Parsons in Labette County, Kansas.

El Paso Natural Gas Company asked FPC authority to build 93 miles of 26- and 30-inch loop on its main line between the Permian Basin and the Arizona-California state line, and 311 miles of field transmission line.

Louisiana Natural Gas Company has started its 145-mile line from Tepetate field to Big Point field, La. Eunice Contracting Company, Eunice, is building 20 miles between Tepetate and Lewisburg.

Michigan Gas Storage asked FPC to authorize 78 miles of 16-, 22-, and 24-inch between Laingsburg Junction, Mich., and the Pontiac-Mt. Clemens area, and 30 miles of 26-inch loops on the Muskegon River-Freedom Junction line.

Mississippi River Fuel Corporation applied for authority to build nine miles of 24-inch withdrawal lines in the proposed Monroe County, Ill., storage field.

New York State Natural Gas Corporation applied for FPC permission to build 77 miles of 20-inch transmission line from the South Bend storage pool, Armstrong and Indiana countries, to the Ohio-Pennsylvania state line in Lawrence County, Penn. Included in the plans are 17 miles of field line and a 12,000 horsepower compressor station in the storage area.

Niagara Mohawk Power Corporation has been authorized to build 15 miles in four lines in Montgomery, Schenectady, and Albany counties, N. Y.

Northeastern Gas Transmission Company has awarded the contract for 100 miles of 16-inch from the Connecticut-New York state line near Greenwich, Conn., to Springfield, Mass., to Britton Contracting Corporation, Washington, Penn.

Ohio Fuel Gas Company asked authority to build 74 miles of pipe line in proposed storage pools in Ashland, Hocking, and Knox Counties, Ohio, and 48 miles of 20-inch to transport the gas to market areas.

Philadelphia Electric Company asked FPC permission to build eight miles of six-inch from Booth's Corner to Chester, Penn.

Public Service Company of North Carolina, Inc., applied to FPC for authorization to build 168 miles in seven distribution laterials to carry gas to 34 North Carolina communities. Six of the laterals will connect with Transcontinental Gas Pipe Line Corporation's line, and the seventh with Piedmont Natural Gas Company's system.

Tennessee Gas Transmission Company asked FPC authority to build 438 miles of loop line on its Buffalo and New England extensions, increasing its system capacity by 40 Mmcf. It wants to develop a storage project which would add 200 Mmcf delivery capacity to its system on peak days, most of which would go to Northeastern Gas Transmission Company.

Tennessee Gas Transmission Company applied to FPC for permission to build 186 miles of loop along its Texas-Kentucky line, and 43 miles of loop along its Buffalo extension. Capacity of the system would be increased by about 45 Mmcf per day, to be delivered to Iroquois Gas Corporation, United Natural Gas Company, and Equitable Gas Company.

Tennessee Gas Transmission Company asked for FPC permission to build 25 miles of 26-inch loop on its Buffalo extension to transport 25 Mmcf of gas to The Manufacturers Light and Heat Company.

Texas Gas Transmission Corporation asked FPC authority to build 160 miles of 26-inch and 35 miles of 24-inch from Acadia Parish to a connection with existing facilities in Morehouse Parish, La.; and 369 miles of 26-inch loop on sections of its system between Morehouse Parish and the Hardinsburg, Ky., area. Plans also call for construction of a new 4400-hp compressor station near Madison, Ind., and installation of 9340 additional hp at four existing stations.

Texas Gas Transmission Corporation asked permission to build a 12-mile line and a 1200-hp compressor station in connection with the development of the Alford storage field near Petersburg, Ind.

Projects Starting

Crude Oil Lines

Mene Grande Oil Company started in January 19 miles of 16-inch in the vicinity of Anaco, Venezuela. Constructora Jack Goebel, Anzoategui, is the contractor.

Phillips Pipe Line Company began in February a 281-mile, 10-inch line from Borger, Texas, to Yale, Okla. Brown Lite Company, Tulsa, and Arey-Phillips Construction Company, Pampa, Texas, are

UNIVERSITY OF MICHIGAN LIBRARIES

joint contractors on the project. The line will have an initial capacity of 25,000 barrels per day, is scheduled for completion in June, 1951.

Service Pipe Line Company is building seven miles of eight-inch in the vicinity of Ranger, Texas. Vaughn & Taylor Construction, Company, Inc., Wichita Falls, Texas, is contractor.

Products Lines

Phillips Petroleum Company is building eight miles of eight-inch from Spearman to Darrouzett, in the Texas Panhandle. Vaughn & Taylor Construction Company is contractor.

Plantation Pipe Line Company started in January 432 miles of 18-inch between Baton Rouge and Bremen, Ga. and 275 miles of 14-inch between Bremen and Charlotte, N. C. Williams Brothers Corporation, Tulsa, is building it.

Natural Gas Lines

City of Trinidad started in February 35 miles of eight-inch to supply the city from Colorado Interstate Gas Company's facilities. Martin Pipe Line and Construction Company, Ulysses, Kansas, is contractor.

Cities Service Gas Company started in January 40 miles of four- through ten-inch in the vicinity of Liberal, Kansas. Knupp Construction Company, Inc., Great Bend, Kansas, is building it.

Oklahoma Natural Gas Company started in February 52 miles of 26-inch between Edmond and Depew, Okla. Trojan Construction Company, Oklahoma City, is contractor.

Texas Illinois Natural Gas Pipe Line Company is building 107 miles of 30-inch from Bloomburg, Texas, to Malvern, Ark. Bechtel Corporation, San Francisco is the contractor.

Trunkline Gas Supply Company is building 178 miles of 24-inch from the Colorado River to Silsbee, Texas. Anderson Bros. Corporation, Houston, started in February.

Union Gas & Electric Company is at work on 32 miles of eight-inch in the vicinity of Bloomington, Ill.

Projects Completed

Crude Oil Lines

Continental Oil Company completed in January, 40 miles of two- through eight-inch gathering system in Albert West field, Live Oak County, Texas. F. M. Reising, Edinburg, Texas was the contractor.

The Texas Pipe Line Company completed in January a 56-mile, 12-inch line between the Chico, Wise County, station and the Wichita Falls, Texas, station. R. H. Fulton and Company, Lubbock, Texas, was the contractor.

Natural Gas Lines

El Paso Natural Gas Company completed in January 247 miles of 26- and 30-inch loops on its transmission line between Eunice, N. M., and Blythe, Calif. Company crews did the work.

New York State Natural Gas Company completed 63 miles of 20-inch from Westmoreland County, Penn., to the Pennsylvania-Ohio state line. The East Ohio Gas Company built a one-mile, 20-inch connection in Ohio to take gas from New York State Natural.

Southern Natural Gas Company completed 252 miles on its Gwinville, Miss., to Aiken, S. C., line. Sheehan Pipe Line Construction Company, Tulsa, completed 180 miles of 18-inch between Gwinville and Selma, Miss.; Associated Pipe Line Contractors, Inc., Houston, built 40 miles of 18-inch from Selma to Elmore, Ala.; Sheehan Pipe Line Construction Company built 32 miles of 16-inch from Elmore to Mitchell Village, Ala.

Trunkline Gas Supply Company completed Sections A and I of its Longville, La., to Joppa, Ill., line. Houston Contracting Company, Houston, completed 176 miles of 26-inch from Longville to Darnell, La., 33 miles of 20-inch gathering line from Lacassine, La., to Longville, and 18 miles of 16-inch from Lake Arthur to Lacassine.

United Gas Pipe Line Company completed in February 60 miles of 16-inch, and 30 miles of 8-, 10-, and 12-inch from the Mississippi River Delta fields in southern Louisiana to New Orleans. Brown & Root, Inc., Houston, was contractor.

Coating field joints on barges in the swamplands of South Louisiana.
HOUSTON CONTRACTING COMPANY
General Contractors
OIL • GAS • GASOLINE • WATER PIPE LINES
LAURENCE H. FAVROT R. P. GREGORY GEO. A. PETERKIN
2707 FERNDALE PLACE HOUSTON 6, TEXAS

The *S. S. Jahra* on her delivery trials.

Supertankers for Superservice

The *S. S. Jahra,* first of more than a score of 28,000-ton supertankers constructed by Bethlehem shipbuilding yards for private interests in the past two years, is an outstanding example of Bethlehem's ability to design and construct ships to meet the specific requirements of the individual operator or of an entire industry.

These vessels represent fulfillment of the petroleum industry's need for big, fast, highly-efficient carriers capable of transporting oil products to and from the far-flung corners of the globe on a low-cost basis.

Fully representative of American postwar shipbuilding skill and achievement, these supertankers can be expected to provide many years of high-standard and low-cost service for their operators, because they have all of the inherent characteristics which for almost half a century have distinguished every ship bearing the title, "Bethlehem-Built."

MAIN PARTICULARS OF THE S. S. JAHRA

Length, overall	624 ft. 9¾ in.
Length, between perpendiculars	595 ft. 0 in.
Breadth, molded	84 ft. 0 in.
Depth, molded	44 ft. 0 in.
Draft, molded	33 ft. 0 in.
Deadweight, tons	28,300
Cargo capacity, bbls.	240,400
Shaft horsepower, max.	13,750
Speed, fully loaded, about	16½ knots

SHIP REPAIR YARDS

Boston Harbor	New York Harbor
Baltimore Harbor	Beaumont, Texas
Los Angeles Harbor	San Francisco Harbor

SHIPBUILDING YARDS

Quincy, Mass.	Staten Island, N. Y.
Sparrows Point, Md.	Beaumont, Texas
Terminal Island, Calif.	San Francisco, Calif.

SHIPBUILDERS *SHIP REPAIRERS*

BETHLEHEM STEEL COMPANY

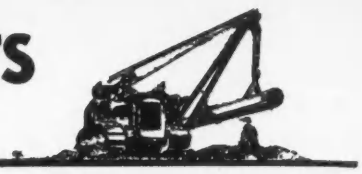
Shipbuilding Division

General Offices: 25 Broadway, New York 4, N. Y.

On the Pacific Coast shipbuilding and ship repairing are performed by the Shipbuilding Division of Bethlehem Pacific Coast Steel Corporation

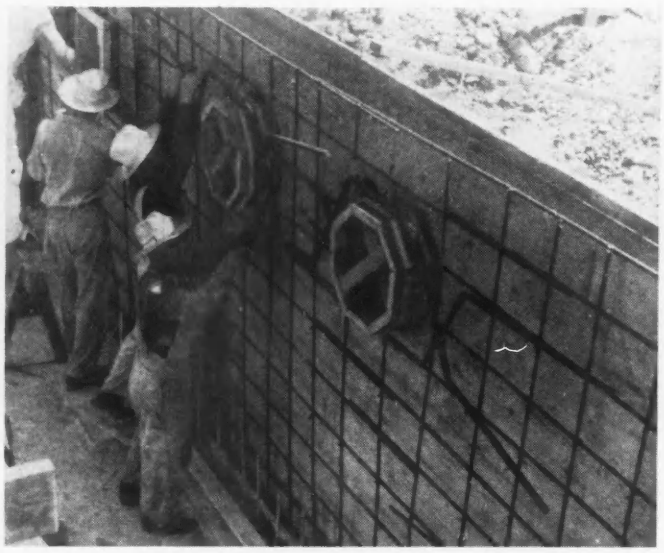
How to do it!

PIPE LINE HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

HOW TO—Minimize Cracks in Monolithic Concrete



Most compressor building walls are of monolithic construction. While this may offer advantages insofar as piping is concerned, it poses a difficult problem for the construction crew. Unless great care and precaution are taken, the resulting wall will become a maze of cracks and checks when the final stage of shrinkage in the concrete has been reached.

With additional care and study it is possible to pour 400 to 500 feet of walls with no cracks and very few checks, notwithstanding the fact that few textbooks are in agreement with this practice. Cracks are primarily a result of the shrinkage that takes place in concrete following the pour, when the walls are placed in tension. The greater the tension, the more cracks occur. And, naturally, they appear at the points of maximum stress concentrations, which are around sharp openings such as window and pipe line openings.

Two ways to minimize such cracks are to reduce shrinkage and to reinforce the wall at the points of maximum stress. Since the shrinkage in concrete is more or less directly proportional to the richness of the mixture and to the amount of water used, it can be minimized by using less cement per batch and less water than usual. For example, if the design mix calls for six sacks of cement per yard, allowing 4½ gallons of water per sack, it is quite possible to achieve the same strength with about five sacks of cement, a quart of wetting agent additive and three gallons of water. And this mixture will have about the same slump as the original mix, because the wetting agent permits better flow. A lab test should always be made in such cases to insure adequate final strength. Such mixtures will, however, greatly reduce the amount of shrinkage.

Some shrinkage will occur, and stress concentrations over openings in the wall will result. Since the stress lines concentrate themselves around an opening similar to water currents around a boat moving in water, additional reinforcing is necessary. To counteract these stresses around openings in the concrete wall, bend heavy scrap steel in the shape of the stress lines and extend the reinforcing members for a distance of at least 20 diameters away from the opening into areas of low stress. This steel is in addition to the amount normally used. It will be found that if these two steps (reducing richness of mixture with a reduction in water, and adding reinforcing steel along stress concentrations at wall openings) are followed, extremely long walls can be poured in a monolithic slab without resultant cracks.

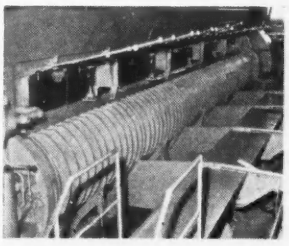
HOW TO—Add Detachable Extension to Cattleguard

By making the cattleguard only wide enough to accommodate normal car and light truck traffic, considerable material is saved, and the entire unit can be set on two foundation sills instead of the three required when a wider crossing is desired.

Clearance for wide trucks, floats and vehicles with overhanging loads is provided through the use of detachable wings or side members for the guard which normally restricts the opening to that spanned by the bars of the roadway in the guard. These detachable wings are welded from two-inch pipe with short sections of ½-inch pull rod set in to form fillers. On the side pipe of the wing are set two pieces of ½-inch rod, with the ends bent down to form hooks. To match these hooks vertical slots are cut with the torch in the upright post, so that when the pins are engaged in these slots the outer end of the wing member rests on the tie pipe of the guard roadway.

A ⅝-inch bolt fits into matching holes in tie member and toe piece of the wing unit, allowing the two to be bolted together, but requiring only the loosening of one bolt to allow the wing to be lifted free, thus giving clearance between the two fixed posts at the extreme edges of the roadway and allowing any width load to be handled without damage.

Water diet for stronger pipe



AFTER Basalt-Kaiser Steel large diameter line pipe has been formed and welded, it is expanded by *water* under great pressure in this modern hydraulic expander.

Result: Increased strength, due to additional cold working. And unusual accuracy in concentricity, diameter and straightness.

Kaiser Steel pipe, manufactured to conform to latest API specifications—in diameters from ½ inch to 30 inches, and in lengths up to 55 feet—is being produced. Shipping points are Fontana and Napa, Calif.

It's good business to do business with

Kaiser Steel

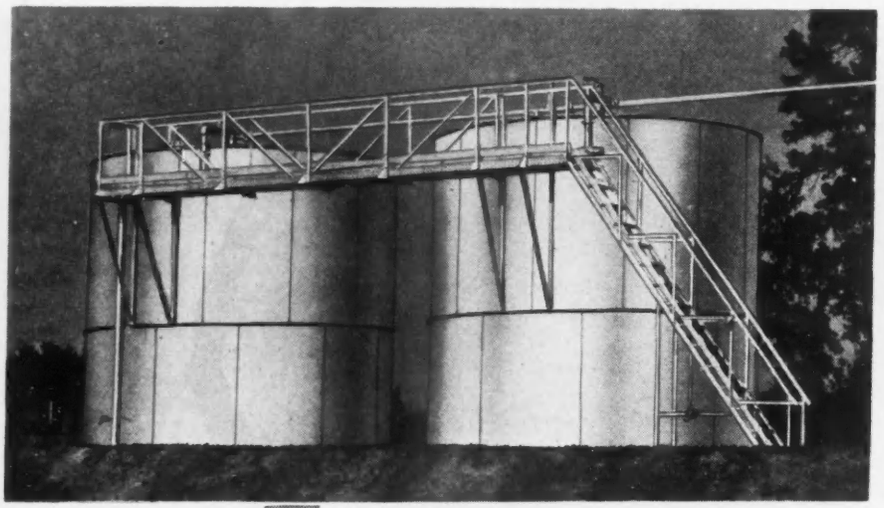
KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	8⅝" to 20" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅛" to 12¾" O.D.	Up to 55'	.188" to .400"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	22" to 30" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser

Prompt, dependable delivery at competitive prices • **KAISER STEEL CORPORATION** Los Angeles, Oakland, Seattle, Portland, Houston, Tulsa, New York

UNIVERSITY OF MICHIGAN LIBRARIES

Butler "Extras" Give You Longer Lasting Tanks!



BUTLER

Bolted Steel OIL TANKS

Easier Erection . . . Butler precision dies produce precision-made tank sheets, punched to fit exactly. These better-made sheets mean faster, easier erection and assure an oil-tight fit throughout the life of your tanks.

Long-Life Surface Protection . . . Electrostatic Painting of all tank parts gives a uniform coating on Butler Bolted Tanks. Each hole . . . each edge . . . each sheet gets a tight, 2-coat paint bond that resists corrosion and rust . . . assures longer life of your tanks.

Also available with Hot-dipped galvanized coatings and aluminum decks.

These "extras" make Butler Bolted Steel Oil Tanks your *best* long-term investment.

DEPENDABLE SERVICE

from these Butler Distributors

AMERICAN PIPE & SUPPLY COMPANY

Casper, Wyoming — Denver, Colorado — Cut Bank, Montana

HARRY G. MILLER

El Dorado, Arkansas

UNION TANK & SUPPLY COMPANY

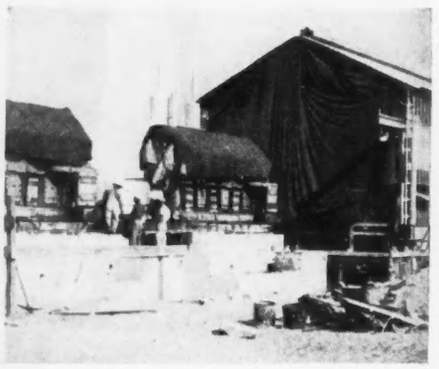
Fort Worth, Texas	Tyler, Texas	New Orleans, La.
Houston, Texas	Midland, Texas	Great Bend, Kansas
Odessa, Texas	Nocona, Texas	Tulsa, Okla.
Snyder, Texas	Lafayette, La.	Oklahoma City, Okla.
Alice, Texas	Ruston, La.	Hobbs, New Mexico

These Butler specialists can also give you service or information on
Walkways • Stairways • Unit Heaters • Other Oil Field Equipment

BUTLER MANUFACTURING COMPANY

Kansas City, Mo. — Galesburg, Ill. — Richmond, Calif. — Birmingham, Ala. — Minneapolis, Minn.

HOW TO— Protect Equipment During Construction

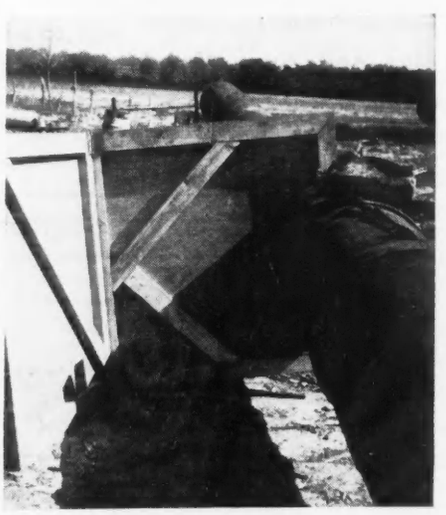


Expansion construction at compressor stations, where additional compressors are to be added to existing facilities, requires that one end of the station building be removed to tie in piping and other equipment. During this construction period of several weeks, the open end of the existing building must be covered to protect operating equipment, yet make it easy for personnel to come and go.

This problem can best be solved by a large canvas covering hung from the end roof truss of the building undergoing the expansion. The expense is considerably less than that of a temporary bulkhead, and the canvas may be used for numerous purposes after the additional building is completed. The canvas may be in one or several pieces, and is normally anchored at the sides and bottoms where infrequent passage is made.

HOW TO— ProvideWelderWith Portable Windbreak

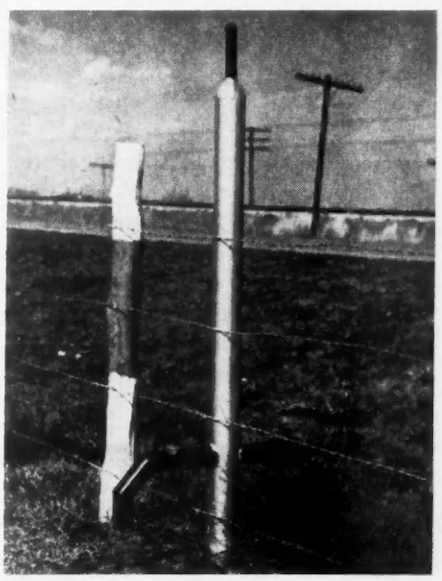
To protect the welder from wind and windblown sand, one contractor furnishes



him a portable windbreak which may be readily moved, and which effectively provides a lee in which to work.

The shelter is made up on a 2 x 4 framework, each section being made 4 x 4 feet in extent and covered with a square of ¼-inch plywood that size. The two sections are joined with a pair of hinges, set on the inside of the frame so that the unit may be folded for storage or transportation. One section is cut out with a keyhole saw to fit a half diameter of the size of pipe being welded and this cutout is fitted snugly against the pipe clear of the weld area with the other half extending out behind the welder.

HOW TO—
Utilize Vent Pipe For Crossing Fence



Even when a pipe line is air patrolled, it is occasionally necessary for maintenance men to cross the fences which traverse the right-of-way. One pipe line company utilizes the vertical vent lines which are set up at the ends of the casings which carry the line under highways as a crossing aid.

The two horizontal vent lines on the riser are set at a height which will allow them to be used as steps for crossing the topmost wire of the fence. At the outer end of each horizontal section of the vents a guard is welded so that the line-walker's foot is protected against slipping.

The horizontal vent lines and a short section of the top of the riser are painted black so as to counteract, in part, the effect of oil-stained shoes and gloves, and thus assist in maintaining the neat appearance of the vent piping. The extended vertical member serves as a brace for the pipeliners to support themselves when stepping over the barbed wire fence.

Super Performance of

SUPER CUB

MEANS MANY NEW USES FOR PLANES

Imagine how useful a plane can be when it takes off in 100 feet and can land just as short on rough, unprepared terrain. Supplies, tools and emergency equipment can be flown to location. Supervisory personnel can cover more jobs more frequently. Medical aid can be reached in minutes.

You can have such a useful plane at a practical price. The new 1951 Piper Super Cub with 125 horsepower takes off shorter, lands shorter than any plane available today.

This two-passenger, special-purpose airplane is just made to order for use in oil fields. It cruises better than 100 mph yet flies as slow as 33 mph when needed. It can carry nearly a half-ton. The '51 Super Cub is a swift, versatile expediter that will pay for itself many times in time and actual money saved. Easy to fly—anyone can learn quickly.

4-PLACE PACER AND TRI-PACER

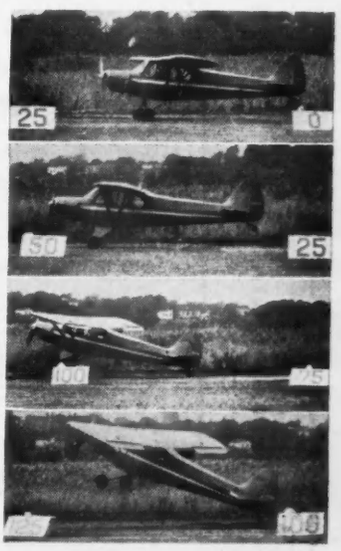
For the most economical executive air travel, choose the 4-passenger Pacer, or Tri-Pacer with tricycle landing gear. Better than 120 mph cruising speed, quiet, comfortable. Costs less to buy and fly than a fine car. Let your nearest Piper dealer demonstrate conclusively how you can use a Piper. Write Dept. L-3 for his name and latest literature on new Piper models.

PIPER

AIRCRAFT CORP.

LOCK HAVEN, PA., U. S. A.

HERE'S PROOF!



High-speed sequence camera catches routine Super Cub take-off in less than 100 feet! Markers give distance in feet. (International News Photos)

UNIVERSITY OF MICHIGAN LIBRARIES

GENERAL
PIPE LINE
CONTRACTORS

Personal Supervision on
Construction of Your

Pipe Lines • Water Lines
Sewer Lines • Excavations
Salt Water Disposals

TROJAN
CONSTRUCTION CO.
INCORPORATED
OKLAHOMA CITY, OKLA.
BOX 4427 · PHONE 2-7696
WAREHOUSE PHONE 6-1430

CONTACT YOUR FAVORITE SUPPLY HOUSE

PARKERSBURG MACHINE CO. PARMACO PARKERSBURG, W. VA. U.S.A.

The House of Courteous Service

For—

PACKERS

★ ★ ★

CASING AND
DRIVE SHOES

★ ★ ★

CASING HEADS

★ ★ ★

We invite you to
STANDARDIZE on

PARMACO

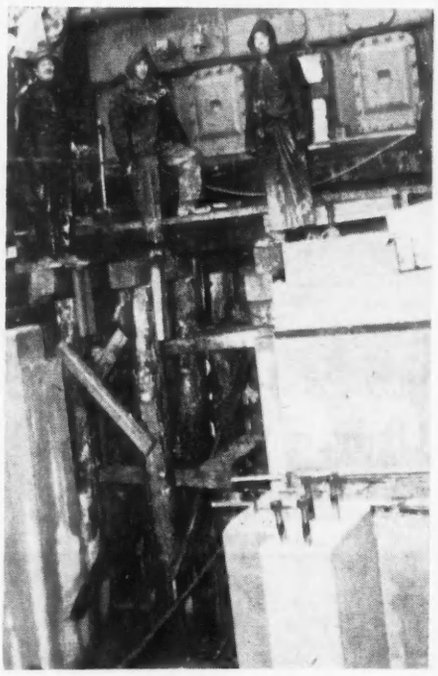
PARKERSBURG
MACHINE
COMPANY
PARKERSBURG, W. VA.

How to—Erect Bridge for Engines

There is a reluctance among some contractors to pour compressor building walls until all engines that go over the wall are in place. Because of varying delivery schedules of 10 or 12 large engines, it is often necessary and feasible to pour the walls prior to the delivery of the engines.

The simple inexpensive bridge illustrated was built for the purpose of skidding the engine over the already-poured compressor wall, and it supported the heavy engine with little or no weight on the wall itself. The upright members were made from trees cut at the time the plant site was cleared. Cross braces of 2 x 8-inch lumber hold these supporting legs in place, and 12 x 12-inch pieces laid across the top of each upright support the runners that carry the engine from the ramp across the wall and onto the compressor block.

This bridge can be quickly and cheaply moved down the compressor wall to transfer adjacent engines over the wall and onto their foundations. Because the pull applied in settling the engine is toward the block, no part of this bridge will press heavily against the compressor building wall. However, care must be taken to tie the ramp outside the wall to the bridge in order that, in pulling the engine up the ramp, the runners be kept in position by deadheading on the engine foundation block, with no

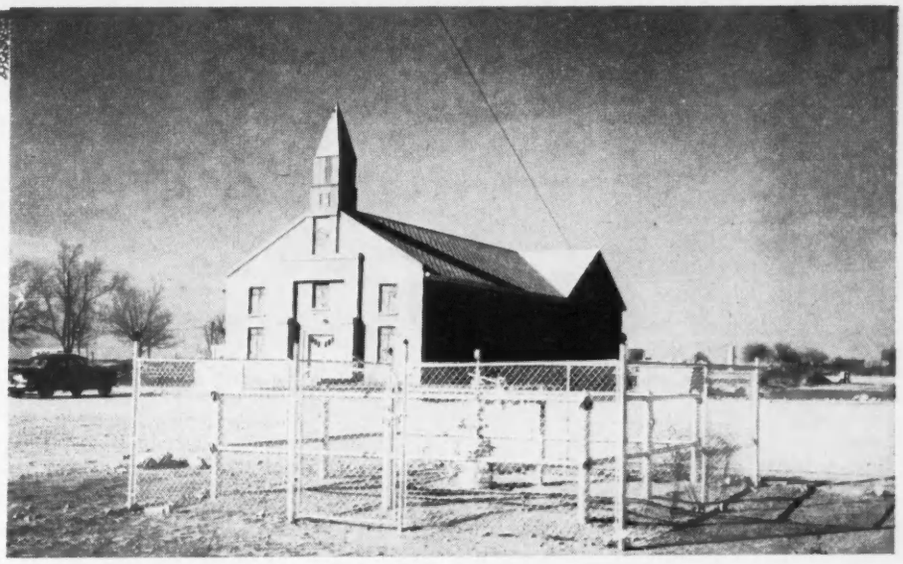


force exerted against the compressor wall. Since the span is short, an elaborate structure is not necessary, but a sturdy one is required. The few pieces going into the construction of this short spanning bridge make it relatively easy to move, and since the salvage value is high, it can be used to set all the engines in one large compressor building.

Gotkool
WATER CANS
& COOLERS
Gott
GOTKOOL
WATER COOLER
PURE WATER
GOTKOOL WATER COOLER
Made in 2, 3, 5, 8, 10, 15 and 20 gallon sizes with Push-Button Faucet.
GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today! . . . .
GOTKOOL WATER CAN
Made in 1½, 2, 3, 5, 10, 15 and 20 gallon sizes. (Push-Button Faucet at slight additional cost.
H. P. GOTT MFG. CO.
WINFIELD, KANSAS
KEEP PURE DRINKING WATER ALWAYS HANDY

KINGDOMS OF OIL

No. 2



The church that oil built. A few miles north of Snyder the Union Baptist Church has a well on its property which enabled the congregation to build this new church last year.

By MARK OLSON

International Editor

A MODERN-DAY oil boom has less of the explosive effects of the oldtimers such as El Dorado, Burkburnett or Ranger, yet the changes wrought by oil even today are, to say the least, sensational. Take Snyder, Texas, the heart and capital of the Scurry County oil boom. A sleepy, solid West Texas ranching community of about 4000 people grew to over 20,000 at the height of the boom, just a year after the discovery of oil in August, 1948. Now the town has settled down to about 12,500 more or less permanent inhabitants.

To appreciate the change that has overtaken Snyder, it is necessary to remember the town as it was a few years ago and to see it as it is today. Many are the oil men who passed through Snyder traveling to and from the oil centers in West Texas in the early 1940's—and this is meant literally for they all passed through the town. Snyder was small, had no first-class hotel accommodations, and worse, it had no oil fields in the immediate vicinty worth mentioning.

From an oil man's viewpoint the town hardly existed, but this does not mean that it was not important to others. For the cattle and cotton men it was the county seat and the only large town in the county. It served its intended purpose of being a supply, educational and religious center for the farms and ranches. Thus, Snyder was adequate. Cotton was a $7 milion annual crop in Scurry County and the cattle population was valued at about $5 million. Other small crops brought in $1 million annually. On this basis, Scurry County's 12,000 people would have gone along on an even keel without much change in any one quarter. Some of the people lived good and some not so good. The small farms depended upon the vagaries of nature to produce a crop of cotton, and in West Texas, rainfall is a little uncertain. During the dry years many of the small landowners lost their places for taxes and moved on to more friendly climates. The oldtimers remained, many of them

RESEMBLING THE oldtime boom towns in its prodigious growth, going from 4000 people to 20,000 in a few months, Snyder, Texas, rapidly got things under control—keeping vice and lawlessness at a minimum. The only thing that got out of hand was housing. Shacks, shanty hotels and jerry-built trailer camps sprouted up out of the wind-swept prairie—but this was only temporary. The oil men knew they were going to be in Snyder a long time so they combined forces with the town to build modern, substantial public buildings and private homes.

This is another of the intimate sketches presented by WORLD OIL so that those engaged in the oil business elsewhere may know "how the other half lives."

UNIVERSITY OF MICHIGAN LIBRARIES

One of the new, modern elementary schools oil built in the north part of Snyder.

descendants of the pioneers who settled the country in the last quarter of the 1800's.

Reef Discovery

Several major oil companies had tried in vain to find commercial oil production in Scurry County with little success. Sharon Ridge and Ira oil fields had been producing oil from shallow depths for some years, but nothing spectacular had been found to warrant major activity. Many of the large companies had taken up leases, drilled, and moved on. These same companies now look on Scurry County with some misgivings but figure it is all part of the game.

Had it not been for the reef formations underlying Scurry County, Snyder today would still be a placid little ranch town. The first reef discovery was Schattel 1, about five miles southwest of Snyder, drilled jointly by Sun Oil Company and Humble Oil & Refining Company in July, 1948. This well found substantial production from a limestone reef which had previously been discounted as non-productive; however, it turned out to be a one-well field. The discovery did encourage other operators, and Magnolia Petroleum Company made its Kelley field discovery in November, 1948, about three miles west of Snyder. Standard Oil Company of Texas followed with a North Snyder field discovery November 21, 1948, and the boom was on! The Diamond M field was discovered by The Lion Oil Company in January, 1949, and the Sharon Ridge Canyon field was discovered by Humble in March, 1949. These fields marked the major Scurry County discoveries and account for the abrupt change that took place in Snyder's way of life.

With $5.5 billion worth of black gold underlying Scurry County something had to give—and Snyder did! It still has a big job cut out for it. It was difficult to accommodate 20,000 people in a town built for 4,000, so Snyder began to build. At first the incoming workers slept any place they could—in pool halls, empty cotton warehouses, wrecked cars, their own cars, trailers, or in makeshift "rooming houses." Hastily built shacks offered beds for rent on a three-shift basis, and every empty space in town contained beds for the weary. Some of the oil workers slept in tents on the well location. Restaurants were swamped with customers and if anything came off the stoves resembling food it was unusual. Eggs were selling for $2 a dozen and supply men were handing them out to customers instead of the usual redeye.

Lease hounds, royalty brokers and salesmen set up offices on the sidewalks, or, in inclement weather, in their cars. One insurance man had sales in excess of $1 million during 1949, operating from the curbstone.

Bank deposits rose from $2 million to $16.4 million in the one established bank and a bank built last year has $5.6 million on deposit. Property valuation for taxes jumped from $6 million to $75 million. Post office receipts have more than doubled and Snyder has a new post office, approximately twice as large as the old one.

Where 100 jerry-built trailer camps once housed 2300 trailers, more than 700 new residential houses have been built and the number of trailer camps has been halved. While there are yet too few houses for everyone who desires one, there soon will be enough. Snyder started the boom with practically no tourist courts and now there are over 26 first-class courts which daily hang out the "Vacancy" sign. For those who prefer to live in trailers, the remaining camps have evolved into first-class places.

New Facilities

What Snyder has accomplished in the line of expansion to handle the bulging population is little short of miraculous. At the outset of the boom, the town found that the school population had increased more than 200 percent. They met this problem, with a $150,000 assist from the oil companies, by moving one building intact from another West Texas town, starting immediate building of new schools, and using church facilities until the new quarters were built. Two old water wells had to be expanded to 22, new water lines were laid, a new sewerage disposal plant was built and new sewer lines laid. Two new 100,000-gallon water towers were erected and a 500,000-gallon ground reservoir built. Six new theaters new replace the former one, and 26 lumber yards exist compared to four previously.

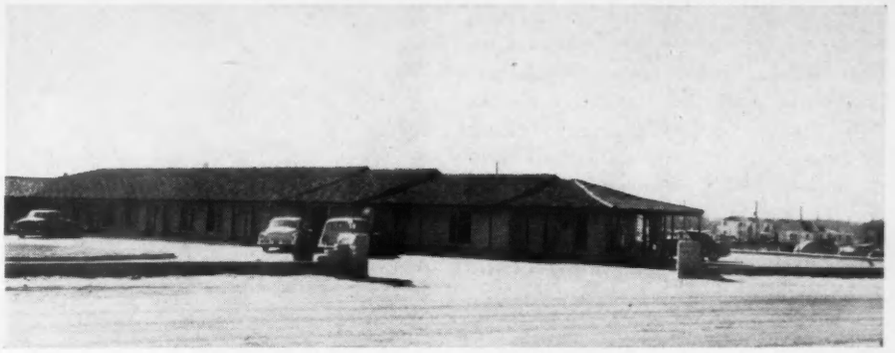
Always strong on religious facilities, Snyder's 12 churches have expanded to 16 and two new ones are building. Two churches have oil production on their property and are prospering accordingly.

A new youth center was built at a cost of $35,000 and a $30,000 rodeo park has also been built. About $50,000 was spent remodeling the country club and $20,000 was spent for the same purpose on a veterans' club. A

Snyder is proud of its new and modern hospital.

$675,000 street paving is under way in Snyder proper and a bond issue of $2.5 million will be used to build farm and oil field roads in the county.

Three gasoline plants are being built in the county and 12 oil companies have built substantial office and residential camps in or near Snyder. In addition, the oil companies have urged and assisted in the voting of $3.5 million in school bonds for expansion of those facilities.



Tourist courts were nonexistent in Snyder before oil was found. Now they are abundant.

Enduring City

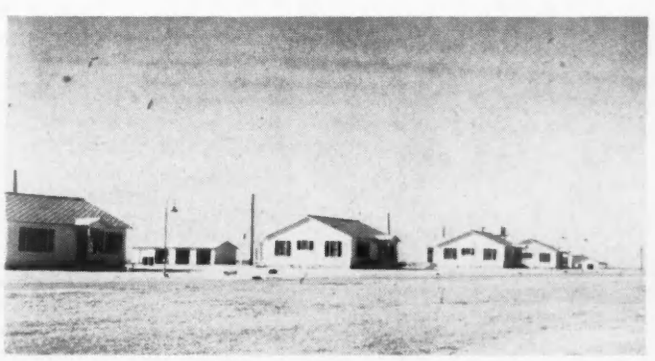
All these past and proposed improvements in the once small town of Snyder indicate why the town was not subjected to a frenzy of boom and bust. Under present day methods of controlled oil production, the oil men know they are going to be in Snyder a long time and they want it to be a town where it is safe to bring their families and where their children will have all the advantages of any other small city in the country. In fact, this trend will probably be the pattern for other towns in the U. S. where oil may be found in the future.

The peak of the drilling boom has passed for the forseeable future. With a top of 208 drilling rigs in operation in June, 1949, the number of active rigs now stands at 80. About 1600 producing wells have been completed in the county and there are probably half that many proved locations yet to be drilled. The market for the high gravity reef crude is good, and the prospects for extended reef and other production in the general area is even better.

The development of an oil bonanza of the size of the Scurry reefs necessarily involves personalities; some men become fabulously wealthy and some miss the boat. A production man with one of the major companies tells of an incident which touched him personally. His parents owned a section of land just outside of Snyder which had been unproductive of anything but dust for years. Finally, the father decided to let it go rather than pay the taxes due on it. He told his son he could pick it up for about $600 but the son could not figure out what he would do with a bowl of dust. After the parents let it go another man got it for a little over $600 in back taxes, and after the Scurry strike a few years later the man sold the mineral rights on the section for $25,000 plus the usual royalty.

For every one who lost there is one who gains. A young widow who held ranching interests in Snyder County for years before oil was dreamed of saw her faith in the country pay off. Her father and husband were oil men and after the deaths of both of them the woman continued to be interested in oil—as well as the ranch which was left her north of Snyder. After a hitch in the Army the woman returned to Scurry County and tried to interest oil companies in coming in, but none of them were interested. During this period of

Low cost sleeping accommodations are still available for the less affluent workers but most of the "shanty" hotels have disappeared.



Oil company residence camps have helped ease Snyder's housing problem.

New homes in Snyder are as comfortable as those in any city.

UNIVERSITY OF MICHIGAN LIBRARIES

unsuccessful negotiations the widow picked up the royalty on 86,000 acres throughout the county — practically for a song. Since oil has been discovered, it would be difficult to estimate her wealth. Her husband had told her before his death that he wanted her to stay in the oil business as much as her income would permit and his wish has been fulfilled. She recently opened a lease office in Snyder and is considered one of the leading social assets of the town. Many of the important improvements in Snyder are credited to her actual participation or behind-the-scenes influence.

One of the more intrepid wildcatters to enter the Scurry County oil play was Bob Hope, shown dressing down his crew.

Others Who Hit

There are others who benefited directly and in a big way; for example, the farmer who had it pretty rough going on a half section of land who is now getting about $12,000 a month in royalties, and many other small landowners who are getting less than this but still more money than they ever dreamed of seeing in a lifetime.

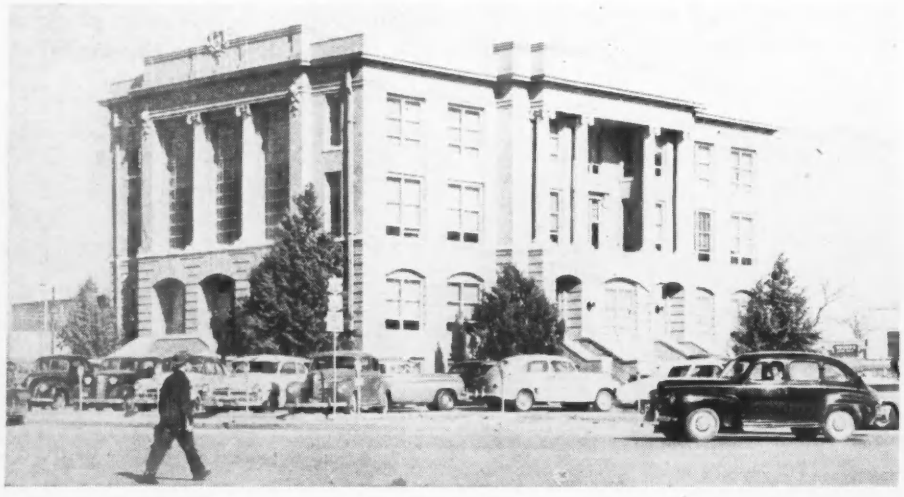
There is always one who qualifies for the axiom: "them that has, gets." One wealthy rancher had moved to Scurry County to get away from the hustle and bustle of his oil properties in North Texas. The Diamond M field, one of the county's largest, was found on his ranch! The overall Scurry County picture further proves the proposition that the free enterprise system is hard to beat. Not just a select few are benefiting from the oil but the entire county, state and nation will reap the harvest.

Oil has put Snyder on the map and the city wants to stay there. While the height of activity brought in such nationally known people as Bob Hope and Bing Crosby, who have an interest in some production, Snyder hopes to consolidate her gains and remain prosperous after the flush of new discoveries is gone. In this connection, the present building campaign is of a permanent nature, following a set pattern designed to be attractive and practical. Public utilities are being expanded on a long term permanent basis to serve the growing community most efficiently. Examples of this are the new sewerage, water, gas and light systems being installed—as well as a new dial telephone system. The schools will be built where they are best situated for the future and a new library is in the planning stage.

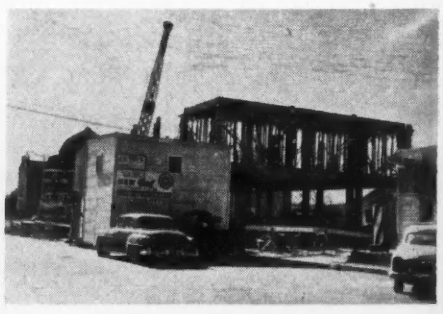
At the height of the oil activity, Snyder developed some undesirable features which will be lost in the long shakedown cruise ahead. Shanties and overnight hotels sprang up along the highways leading out to the oil fields. These will disappear as the town regroups and consolidates into a more orderly pattern. Most of the unsavory characters who spring out of the bushes at every oil strike will gradually move on.

While Snyder's oil boom resembled the oldtimers in some respects many aspects of an oil town were missing. Located as it is in the parched-throat zone between Fort Worth and Midland, Snyder has not permitted the legal sale of beer or hard liquor and the absence of honky-tonks is notable. In spite of the large numbers of newcomers the first beer election in the town since 1902 was defeated last year by a majority of 3 to 1. As in most dry communities the law enforcement agencies turn their backs on the citizens' drinking habits as long as the situation does not get out of hand. Generally, law enforcement has been no problem in Snyder since the police department was expanded and modernized. The incidence of crime, minor or major, has been remarkably low. However, in line with the town's expansion program, a new jail is being built.

Snyder had another singular distinction, which few oil towns had. A song was written about it. Titled, "I'm a Toolpusher From Snyder," the song goes into great detail describing the ups and downs of oil well drilling in Scurry County and elsewhere, and ends with the tear-jerking plaint that the singer will go on pushing rigs in Snyder until he is six feet underground.



Snyder's renovated courthouse.



The new telephone building.

Come on down the Well

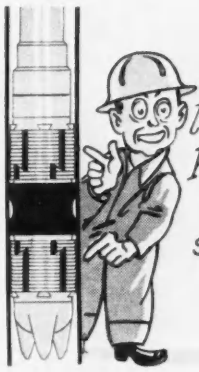
YOU'LL SEE WHY

LANE-WELLS *Drillable* BRIDGING PLUGS

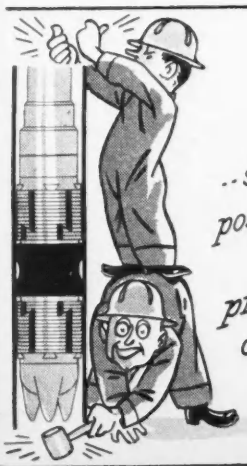
PERFORM SO WELL!

--greater clearance means faster running

--longer self-sealing element gives positive leak-proof pack-off



--BIG interlocking slips hold fast with minimum strain on casing



--simple, positive setting resists pressure up or down

--removable ram adapter means faster knock-out

"Get 'em - Set 'em - Forget 'em or Drill 'em!"

Ask Your Lane-Wells Man!

LANE WELLS

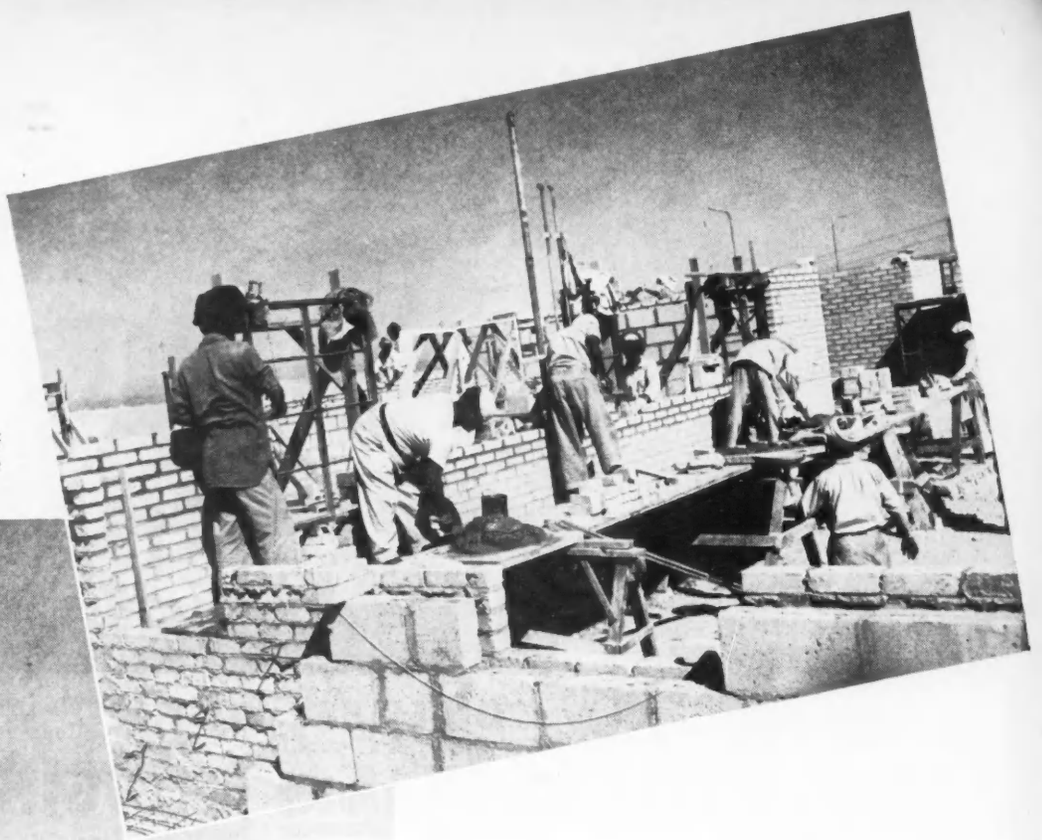
TECHNICAL OILFIELD SERVICES

Los Angeles • Houston • Oklahoma City • Lane-Wells Canadian Co. in Canada • Petro-Tech Service Co. in Venezuela

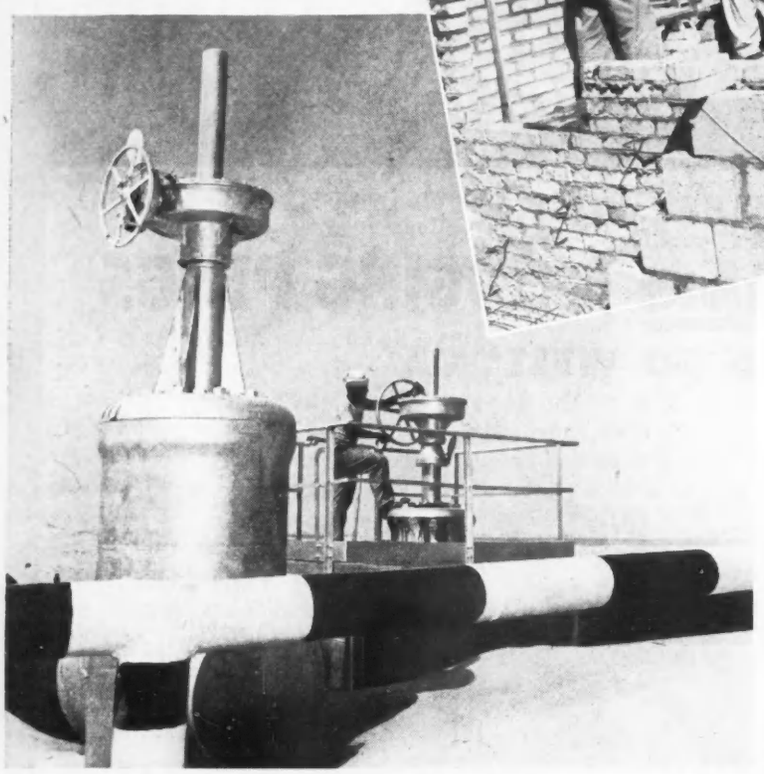
General Offices, Export Office and Plant • 5610 So. Soto St. • Los Angeles 58, California

AU-50C

RIGHT: Employes of private Saudi Arab contractors construct bachelor dormitories in Dhahran, Aramco's headquarters community in Saudi Arabia.



BELOW: A Saudi Arab employe of Aramco adjusts an oil pipe line on the desert near Dhahran.

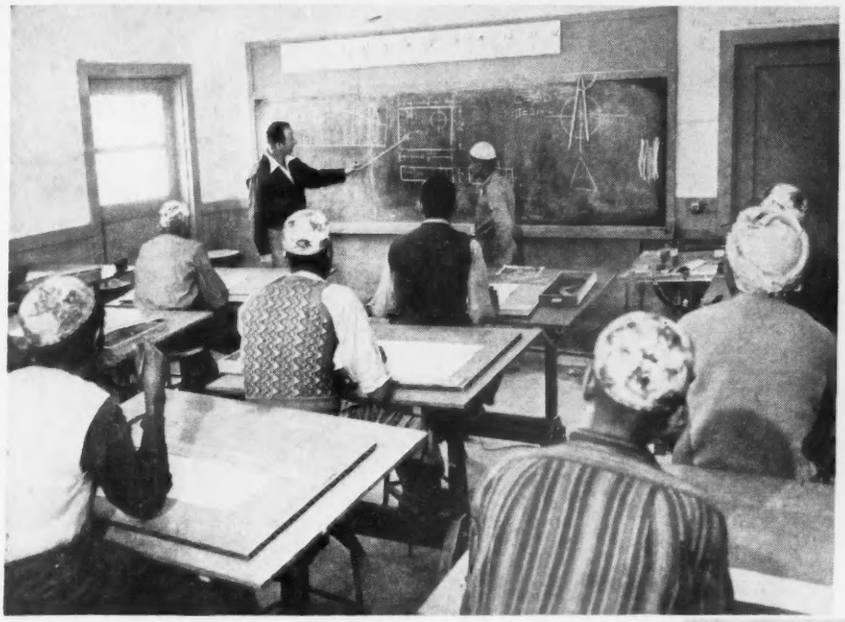


Aramco Contributes To Saudi Arabian Private Enterprise

—Photos courtesy Arabian American Oil Company.

These Saudi Arabs are employed by a private Arab contractor who is working on the new Saudi government railroad nearing completion. This railroad is being paid for out of oil royalties the Saudi government receives from Aramco.

Saudi Arab on-the-job trainees learn to work on metal lathes in the well-equipped Aramco machine shop at Dhahran. Many of the young men trained in this way go on to work for the company or for the many private Saudi Arab business firms springing up in Saudi Arabia and encouraged by Aramco.



LEFT: Aramco's technical school for Saudi Arab employes. Aramco encourages employes to accept greater responsibilities that come with technical know-how and better jobs. This school, in Dhahran, is one of several operated by the company for employees.

BELOW: American and Saudi Arab welders at work on the 30-inch pipe line gathering system near Abqaiq. Trained in use of latest equipment and schooled in safety measures.

LOWER LEFT: Once the property of Aramco, this contractor's truck was sold by the company to private Saudi Arab business men who contract jobs for Aramco.

LOWER RIGHT: An American engineer, an Aramco employe, reads blueprints with a Saudi Arab contractor's foreman on a Saudi camp construction site in Dhahran.

INCREASING productivity of Saudi Arab nationals is raising the earning power of the worker and his standard of living. In 1946 the Arab Industrial Development department of Arabian American Oil Company started with the modest idea of advising and assisting Saudi Arabs on industrial development. So extensive had that work become by 1949 that 331 contracts had been let to Arab businesses, with a total value of 4½ million SR.

Local contractors are active now in industrial endeavors. They build walls, tanks, slabs and piers, are helping to build the Dammam-Riyadh railroad and to maintain tracks. They also install sewers, water lines, plumbing and pipe lines. They have become proficient in excavation work and also operate garages, grease racks and repair tires and machinery.

As a result of the Aramco program, the Saudi Arabs are learning the lesson of free enterprise and the function and importance of capital in industrial work.

About 112 contractors and contracting companies are now doing work for Aramco and TAPline. This represents an employment force of 9000 and the use of 300 pieces of automotive equipment.

UNIVERSITY OF MICHIGAN LIBRARIES

Pakistan Activity Quickens

Water was a problem at the Sui well site as the nearest surface water was the Indus River, 45 miles across deep sand. This water well drilled at the well campsite came in for 10,000 gallons per hour but was too salty for use.

BURMAH Oil Company, operating in Burma, India and Pakistan, has formed a subsidiary, Pakistan Petroleum Limited, to carry on extensive exploratory work in Pakistan. Under the new Pakistan Petroleum Production Rules, passed in 1949, every applicant for an oil development concession should be either a national of Pakistan or a company incorporated in Pakistan. In general, the rules are on the same order of those applying to foreign companies in Canada and Venezuela and interest in Pakistan's oil future has stepped up accordingly.

Pakistan Petroleum's big operation at this time is the moving in of equipment and preparation of a well site in the Patharia Forest of East Pakistan. The movement of the well equipment was a major operation in itself. About 1500 tons of equipment, valued at about $600,000 was moved by boat from Karachi to the port of Chittagong, the nearest transport point to the well site in the Patharia jungle. Several months were required by native labor to prepare roads through dense jungle before the equipment arrived at its port of debarkation. The well site itself is on the top of a sharp line of hills in the heart of the jungle, and road preparation involved a great deal of heavy earth cutting near the well site as well as preparing a passable road on the plains approaching the Patharia area. When the well is ready to spud in March, a complete and self-sufficient community and well equipment service center will be at the site.

Burmah Oil had found good shows of oil in this area before but operations were suspended pending settlement of the boundary dispute between Pakistan and Bharat. The first well, besides finding oil, developed evidence of extreme folding in the area and the possibility of a major fault bordering the western side of the structure.

Followup Test

In West Punjab, Burmah Oil drilled a followup to its Chakwal 2 discovery in the Sakesar limestone. Though only slightly lower in structure than the discovery, the new well found only small amounts of production after shooting with 500 pounds of nitroglycerin and several acid jobs. Following these discouraging tests in the Sakesar the well was deepened to the Lavender Clays (Upper Carboniferous series) without finding production, although the Khairabad limestone farther up the hole showed traces of oil. Crews moved on to another location in the area last month.

The Balkassar field, in West Pakistan, had a southern extension when Burmah Oil drilled Balkassar 4. Some difficulty was experienced in this well at 5900 feet when a high pressure water zone was encountered, but after some delay the well was carried on to the Sakesar limestone, which is the productive formation in the field. Four fields now produce in West Pakistan: Khaur, Dhulian, Joya Mair and the Balkassar.

Pakistan Petroleum has other wildcat ventures slated for this year in Punjab and Baluchistan. Seismograph work in the Chak Naurang area of the Punjab has developed a promising structure, just east of the Balkassar field and a well will be put down to seek Sakesar production. Work has already started to move well equipment into the Sui area of Baluchistan. As in most areas of the country, transportation is the big problem. A two-foot, six-inch gauge railway runs to within 35 miles of the planned well site at Sui and moving the 4000 tons of equipment over this system has been a major undertaking. The terrain is predominantly desert sand and moving the equipment from the railhead is a problem. The well is expected to be spudded during the first half of this year.

Pakistan's oil production is small as compared with the other countries of the world, but the industry there is also relatively new. Production increases in the past three years have been remarkable. In 1948, total production was 560,000 barrels; in 1949 the figure almost doubled to reach 936,000 barrels; and in 1950 the total production was close to 1,500,000 barrels.

Earth moving operations necessary to clear and level site for the Patharia test. Native labor was used extensively in the moving-in operations.

Pakistanis surveying water line route for Patharia well through dense bamboo jungle.

The cleared area on the top of the hill will be the site of the well. Foundation for a store building is in the foreground.

Typical jungle terrain in Patharia at beginning of clearing operations for the test well.

UNIVERSITY OF MICHIGAN LIBRARIES

Leduc D-3 Zone Pool

By JAMES E. BAUGH

Petroleum Engineer, Sun Oil Company

FOLLOWING the discovery of the Leduc field in February 1947, by Imperial Oil Limited, when Imperial Leduc 1 obtained commercial oil production from the D-2 zone of the Devonian formation, the followup well, Imperial Leduc 2, was drilled deeper and discovered the D-3 zone reef pool about 150 feet below the base of the D-2. D-3 proved to contain a larger reserve and to have better producing characteristics than D-2 and has been quite rapidly developed to date. At the time of preparation of this material, there were about 306 completed producing wells in the D-3 pool. Estimates of future development indicate that there will possibly be 450-475 D-3 wells drilled.

Geology and Structure

The Devonian in the Leduc area contains three porous zones designated D-1, D-2 and D-3 from the uppermost to the lower zone. The D-1 is brecciated dolomite and limestone with local stringy porosity and some anhydrite inclusions and filling. It has yield shows of oil and gas but there are no commercial wells in the D-1. Below the D-1 occurs a bed of red and green dolomitic quartz silt known locally as the Red Beds or Red shale. This shale is from 20 to 30 feet thick and segregates the D-1 and D-2 zones. The D-2 zone is about 150 feet thick and is a light brown dolomite. It varies from silty to argillaceous and contains much anhydrite infilling. The green shale; also about 150 feet thick in the Leduc area, lies at the base of the D-2 zone and forms the cap rock for the D-3 zone reef pool below it.

The D-3 zone pool is comprised of a local high on a large coral-type reef. The areal magnitude of the reef is not known, although a few wildcats some miles from the oil-producing area have encountered the reef well below the water level of the pool. The D-3 consists of a light brown dolomite with porosity occurring both as inter-granular and vuggy porosity with some fracturing. Wherever encountered outside the producing area, the reef has been found to be porous and water-bearing. It is estimated to be up to 800 feet thick.

Figure 2 is a type log section of a Leduc field well indicating average thickness of the formations discussed above. Figure 1 is a cross section along a general north-south line through the field.

The oil occurs above a water level of 3020 below sea level and the full oil column is 38 feet in thickness. A large gas cap overlies the oil zone above a subsea depth of 2982 feet. The maximum structural relief above the water line is 246 feet.

In the small isolated high at the southern end of the field, the oil-water contact occurs at 3025 feet subsea and the gas-oil interface at 3005 feet subsea. Thus, the oil section in this southern portion of the pool is only 20 feet in thickness.

The Association of Petroleum Geologists of Alberta recently accepted a new nomenclature for the formations in the Edmonton area, and specifically for the Leduc field. In this paper the original nomenclature was used throughout, because of its wide past usage. Figure 3 presents the newly authorized names for the formations referred to herein.

The porosity of the Leduc D-3 dolomite is very good, averaging about 13 percent. Preliminary estimates have

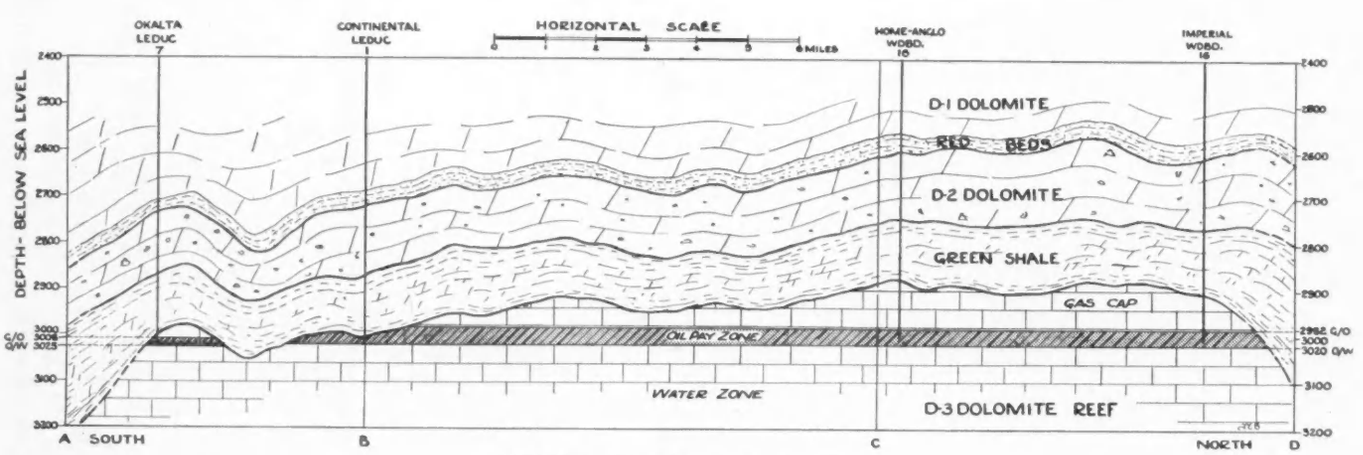


FIGURE 1. Cross-section, Leduc field.

indicated the distribution to be roughly 50 percent vuggy and 50 percent inter-granular. The vuggy porosity and the fracture system associated with it, give the reservoir rock an excellent permeability. Core analysis techniques do not permit an accurate determination of average permeability since the vugs are large in size. All core laboratories are using full large section cores in analytical work to eliminate as far as possible the effect of these vugs.

In this respect also, diamond coring has been used extensively in the field to obtain near 100 percent core recovery. Also, from the driller's standpoint, considerable lost circulation difficulty has been met as a result of the excellent rock flow properties. In most D-3 completions, lost circulation is encountered to some degree.

The table of reservoir data summarizes these properties.

Reservoir Fluid Properties

Original reservoir pressure in the Leduc D-3 pool was 1894 pounds per square inch gauge measured at 2980 feet below sea level. Reservoir temperature was 152° F. The solution gas-oil ratio of the saturated reservoir fluid as determined by differential liberation on a subsurface sample was 779 cubic feet per barrel on a residual oil basis. Shrinkage from reservoir to stock tank conditions was 0.685.

The crude averages 39° gravity and contains very small amounts of chlorides and sulphur compounds. It is considered "sweet" and a very desirable refinery stock.

The table of reservoir data summarizes the properties of the reservoir fluid.

Production History and Characteristics

The bottom-hole pressure decline graph (Figure 4) shows pressures as determined from averages of individual well pressures. Due to the excellent reservoir rock permeability, pressures build up rapidly in D-3 zone wells to an equilibrium. Build up is normally complete in 24 hours after shutting in a well. Productivity indices of wells are about 5-20 barrels per day per pound pressure drop. Also, pressures equalize rapidly across the field and individual wells do not deviate appreciably from the average.

The field average gas-oil ratio curve has been determined from pool total oil and gas production statistics. The rather erratic nature of the curve is no doubt due to some errors in measurement and incomplete measurement of gas from testing wells. Since separator pressures are generally quite high (from 50-100 psig) the measured gas-oil ratios are somewhat less than the previously mentioned solution gas-oil ratio. Also indicated on the chart are the production losses estimated for the Atlantic 3 blowout which occurred during the summer of 1948. This well was out of control for almost six months after total circulation loss was experienced upon drilling into the D-3 zone. When the open hole was exposed to the formation pressure after loss of drilling fluid, gas and oil started to crater at the surface around the well site from below the 300 foot string of surface casing. The drilling crew was forced to leave the

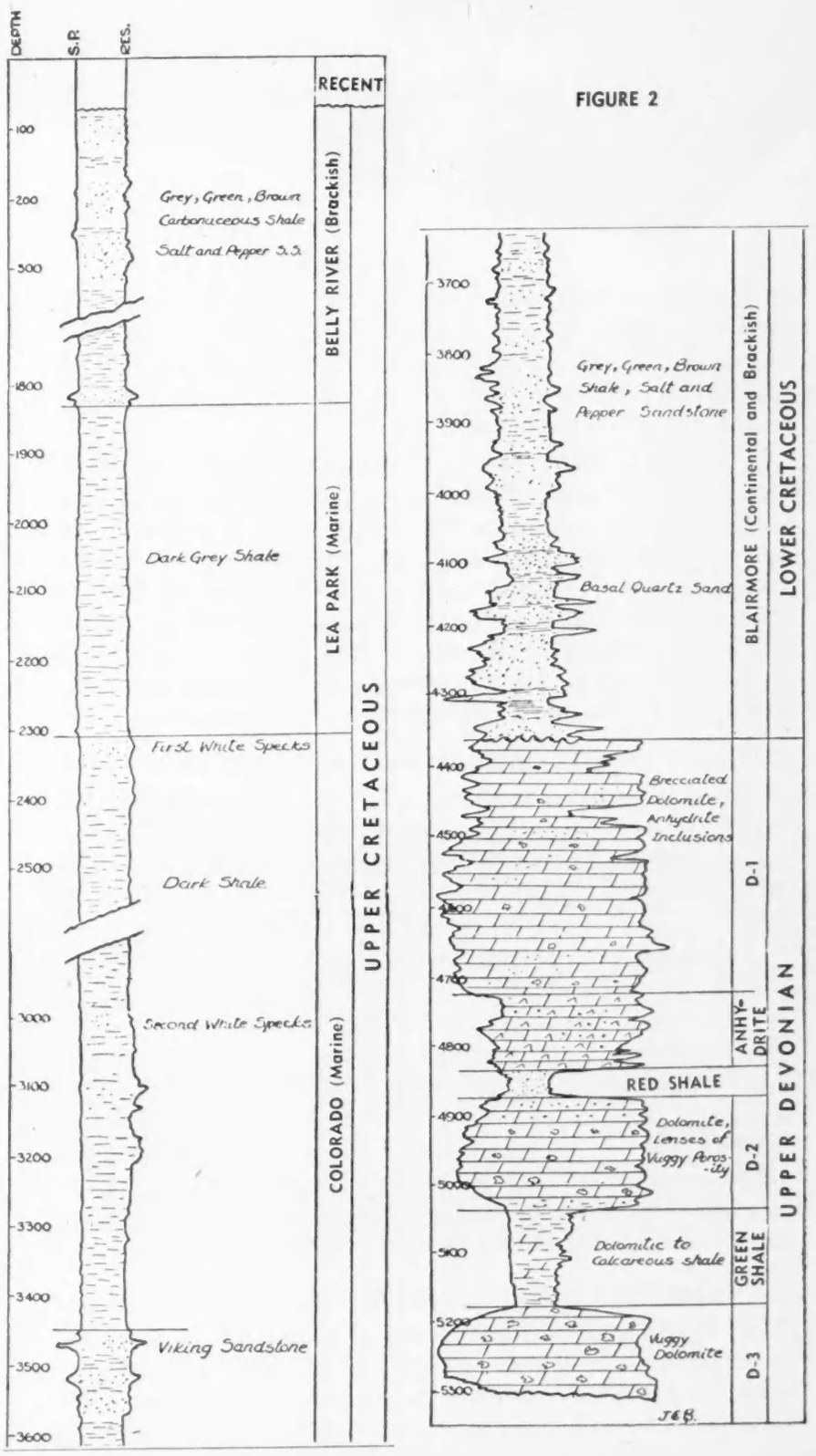


FIGURE 2

"KEEP IT CLEAN"

Just *choose the type* BAKER CASING SCRAPER your job requires

If you have ever tried to run a swab and had the rubber cups so badly torn and damaged that they were useless – if you have ever hit a spot through which a packer or cement retainer would *not* run and had the slips set prematurely – you already *know* that the inside walls of casing should be scraped clean.

There is no longer need to have imbedded bullets, burrs from gun-shot holes, a hardened cement sheath, or any other obstructions, cause you trouble. Anything that projects from, or adheres to the important "working surface" of casing – even down to mill scale or rotary mud – can be quickly, easily, safely and economically removed from the inside wall of the casing. And this vital work of scraping can be done either while the rotary rig still is up and you are drilling out the cement shoe; or at any convenient time by running the scraper on tubing or a wire line for vertical removal of obstructions.

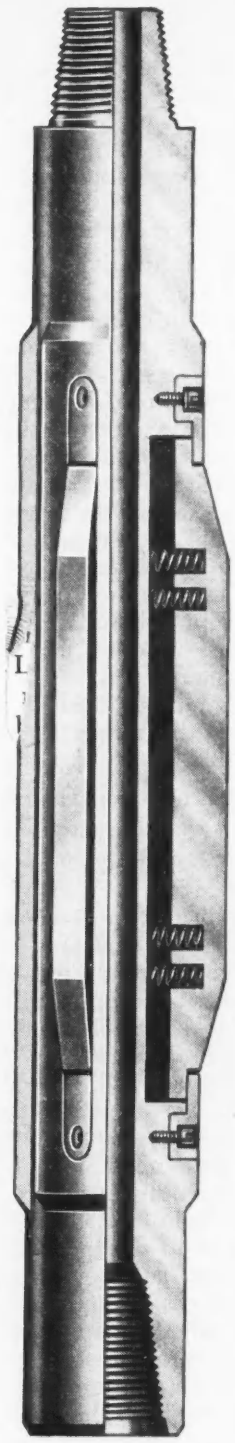
TWO TYPES OF BAKER CASING SCRAPERS MEET EVERY REQUIREMENT

The field-tested Baker MODEL "B" Casing Scraper (Product No. 620-B) is recommended for use when the rotary rig still is up and only hardened cement or a limited number of gun-shot burrs are to be removed. It is usually run just above the bit while drilling out cement, and will remove protruding burrs as well as the thin sheath of cement left even after the maximum gauge bit has been used for drilling out.

When there are several hundred gun-shot holes (with possible imbedded bullets); or if the hardened sheath of mud is to be removed from top to bottom of the well, the new Baker ROTO-VERT Casing Scraper (Product No. 620-C) is recommended. The ROTO-VERT can be run on drill pipe for successful vertical scraping of obstructions as it is being lowered in the hole, followed by rotation if difficult well conditions make rotation necessary or desirable; or it is run on tubing or a wire line for successful all-vertical scraping.

SCRAPING IS A VITAL PART OF WELL COMPLETION

Many operators consider that the use of a Baker Casing Scraper is a "must" in the completion of *every* new well, and after *every* gun-perforating job. They *know* that the inside wall of the casing is left smooth and "clean as a hound's tooth" ready to run a swab or testing



Baker MODEL "B" Casing Scraper
Product No. 620-B

tool with no trouble. They *know* that the tubing or liner can be run easily and safely, and that packers and cement retainers will run-in readily and seal-off perfectly against the clean, smooth inner surface of the casing. Not only is the well then ready for immediate completion, but it will be left with the "working surface" safe for all future down-hole work. Isn't the reasonable rental charge for a Baker Casing Scraper cheap insurance for leaving your well in perfect condition?

Baker ROTO-VERT Casing Scraper
Product No. 620-C

THE NEW BAKER ROTO-VERT SCRAPER IS POSITIVE AND SAFE

The strong, simple construction of this efficient scraper is evident from the illustration which shows the rugged body on which six blade blocks are mounted, and held in position by blade block retainers. These blade blocks are set in two horizontal rows in a staggered position so that the blades overlap and will scrape the full 360° surface of the inner wall of the casing. The scraper blades are cut on a helix angle and provide a scraping, or shearing, action both while moving down the hole and while rotating. The thrust of each blade block, when rotating, is taken by a driving block which is welded to the body. Springs behind each blade block hold the hard-faced scraper blades against the inner wall of the casing where they exert positive shearing action. ROTO-VERT blade blocks will never screw down past a casing burr because their scraping edges follow the contour of a LEFT-HAND SCREW.

Field reports on the ROTO-VERT Casing Scraper prove its efficiency when used as recommended for the removal of a large number of burrs from gun-shot holes, and possible bullets imbedded in the casing. A ROTO-VERT used on two consecutive jobs scraped a total of 1,548 perforation burrs WITH THE SAME SET OF BLADE BLOCKS, and the blades were still in usable condition. Further proof of the complete, clean removal of burrs was provided when the swab cups used in connection with washing the perforations in both wells, were found upon removal from the well, to be in good condition.

You'll always be glad you scraped the "working surface" of your casing

Descriptive literature is available on both types of Baker Casing Scrapers—or, better yet, ask the Baker representative in your area how you profit when you use a Baker Casing Scraper to "KEEP IT CLEAN."

BAKER OIL TOOLS, INC.
Houston • Los Angeles • New York

UNIVERSITY OF MICHIGAN LIBRARIES

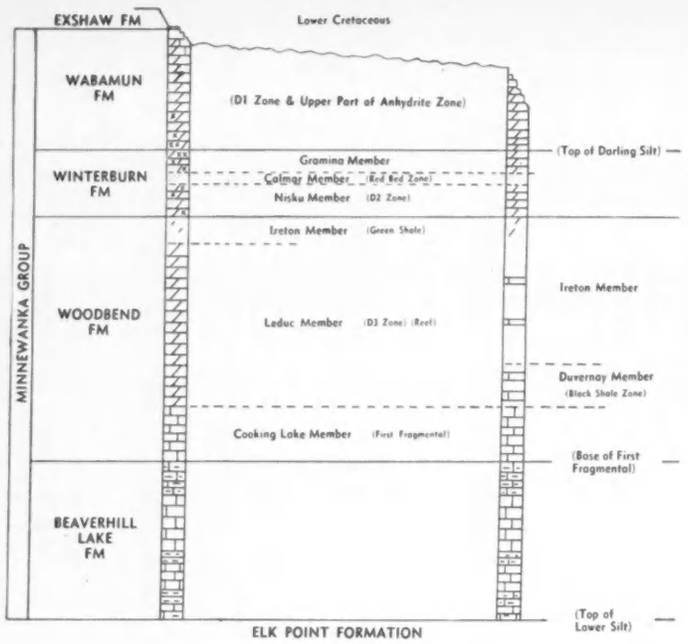


FIGURE 3

Generalized chart showing the Devonian terminology in the Edmonton area. Terms in brackets are the names being replaced.

rig and operations were commenced to kill the well by means of two relief wells, directionally drilled to intersect the wild well at the top of the D-3 formation. During the drilling of the relief wells, water was injected into an offset completion in an attempt to kill the wild well, but to no avail.

It is estimated that during the six month period from March 8, 1948, to September 10, 1948, the well produced about 1,400,000 barrels of oil and some 25 billion cubic feet of gas.

Figure 4 shows the field average bottom hole pressure decline versus production of stock tank oil. Showing a recovery of pressure in the field after the Atlantic 3 blowout, it indicates the possibility of a water drive. Although the reef volume is not known to be large, it is expected that some water influx into the oil zone can be expected. Gas cap expansion, however, will probably play the major part in the recovery mechanism. In view of the good drive mechanism and rock flow properties, a recovery as high as 50 percent of the oil in place has been estimated.

The table of reservoir data (page 214, February 1 issue) shows an estimate of the reserve in place in the Leduc D-3 zone pool calculated by the porosity-area method. This result, of course, is subject to an estimated percent recovery factor which will be more closely evaluated after further production from the pool. Various estimates of the recoverable oil in the pool range from 175-200 million barrels. This would correspond to a recoverable oil per acre foot value of about 280-320 barrels.

General Practices

The lost circulation problem previously mentioned has caused the operating companies to adopt a precautionary casing program specified by the Petroleum and Natural Gas Conservation Board. The normal D-3 zone well casing program includes a 300-foot string of 10¾-inch surface casing cemented full length, a seven-inch string set in the green shale and cemented to above the Viking sandstone (which is generally gas bearing) and a 5½-inch liner set through the gas cap and perforated in the oil zone.

Well drilling times average about 30 days and except for lost circulation, drilling difficulties are not great. Acidization is used only to a minor extent, generally small "wash" shots being the only chemical treatment.

With a very few exceptions, Leduc D-3 wells are flowing wells and do not require pumping. This is due to the saturated condition of the crude. Water production with the crude is not yet a serious problem since per-well production rates are quite low. About 20 wells are producing various amounts of water up to 10 percent of the gross fluid production.

ACKNOWLEDGMENTS

The author wishes to express appreciation to the Petroleum and Natural Gas Conservation Board of Alberta for making these data available; also appreciation is expressed to the Imperial Oil Limited Producing department, from whom the majority of the core analysis and reservoir fluid analysis data was obtained.

This article first appearing in the *Canadian Oil and Gas Industries* for July, 1950, has its figures brought up to date.

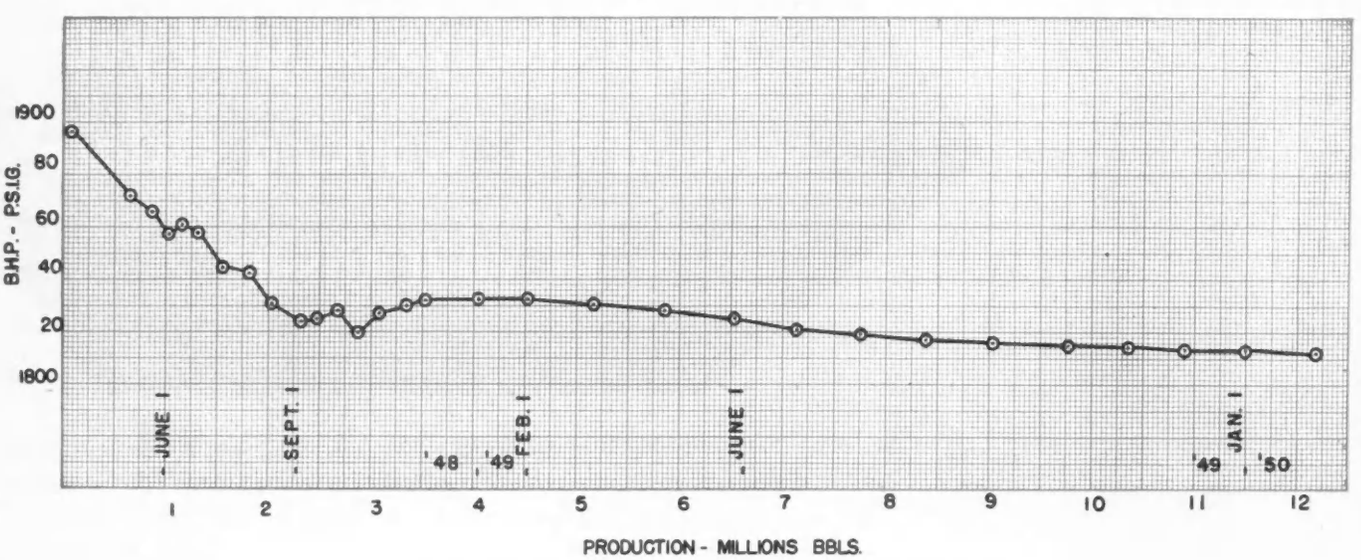


FIGURE 4. Bottom hole pressure decline curve of Leduc D-3 zone.

Of World Oil Men

LEADING NOMADIC LIVES, oil men in international operations would need seven-league boots to retrace their former travels and renew old acquaintances. As this is impossible, even for oil men, WORLD OIL will try on these pages to bring its readers up to date on old acquaintances, covering their past histories and pinpointing their present whereabouts.

THE Texas Company announced the retirement the first of the year of Rodolfo Ogarrio, vice president and director. This ended Ogarrio's direct activities with the company, but his career was too varied and successful to permit him to drop out of the oil picture entirely. He will continue in a consulting and advisory capacity for foreign operations while taking life easy in his beautiful home in Mexico.

Rodolfo Ogarrio

Born in Juarez, Chihuahua, Mexico in October 1888, Ogarrio attended St. Louis College, now St. Mary's University, San Antonio, for his elementary schooling. He went from there to Massachusetts Institute of Technology and Sheffield Scientific School at Yale University, where he received his degree in civil engineering in 1908. He went to Mexico City from college and engaged in engineering construction work until October, 1916, when he joined The Texas Company of Mexico at Tampico.

His climb up the company ladder was rapid, and by 1920 he was made general superintendent and a director of the company in its Mexican fields. Going over to the Texas Petroleum Company in 1925, he became general manager of the Colombia and Venezuelan operations, where he spent three years directing operations in those countries. By this time his range of friends and acquaintances in foreign oil operations was wide.

The parent Texas company recognized a good man when it saw one and in 1928 Ogarrio was elected vice president in charge of production for the entire company and was stationed in New York. In this work he traveled as much as possible back to the foreign fields and was greatly responsible for the expanded world-wide operations of Texas. In 1931 he was made a director of the company and applied his vast knowledge of foreign work to company policy. The added responsibilities cut down his foreign travel and he gradually lost track of many of his old friends in other countries. He hopes now, with more leisure time, to be able to renew old contacts he has missed.

Spending 34 years with one oil company is a remarkable record in itself, but Ogarrio was not content to limit his time to one job only. During his career with Texas he was also a member of the board of directors of Seaboard Oil Company, Coltexo Corporation, Colombian Petroleum Company, South American Gulf Oil Company and The American Petroleum Institute. He also served as chairman of a Texas Company executive committee considering crude oil production on a worldwide basis.

When Ogarrio returns to Mexico, with his wife and daughter Ana Elena, he takes with him a wealth of international petroleum knowledge and many fine memories of a full and useful life.

PANTEPEC Oil Company C. A. and its affiliate, Pancoastal Oil Company C. A., got a new president at Caracas the first of the year when Louis W. Storms, Jr., succeeded Florent H. Bailly, who went into consulting work. For Storms, a petroleum engineer and production specialist, the new assignment climaxes five years with Creole Petroleum Corporation and 18 years with other Standard Oil Company (N. J.) affiliates in South America.

Louis W. Storms, Jr.

Besides his many friends in South American oil circles, Storms is well known in the U. S. oil industry, where he served with the Petroleum Administration for War in Washington during World War II.

THE Atlantic Refining Company announced appointment of Richard C. Harris as resident manager of the company's operations in Venezuela. He will be stationed in Caracas.

Harris first became associated with Atlantic in 1938 as resident geologist in its Foreign Producing department in Havana, on May 1, 1941, he was named chief geologist and transferred to the company headquarters in Philadelphia where he has served until his present appointment.

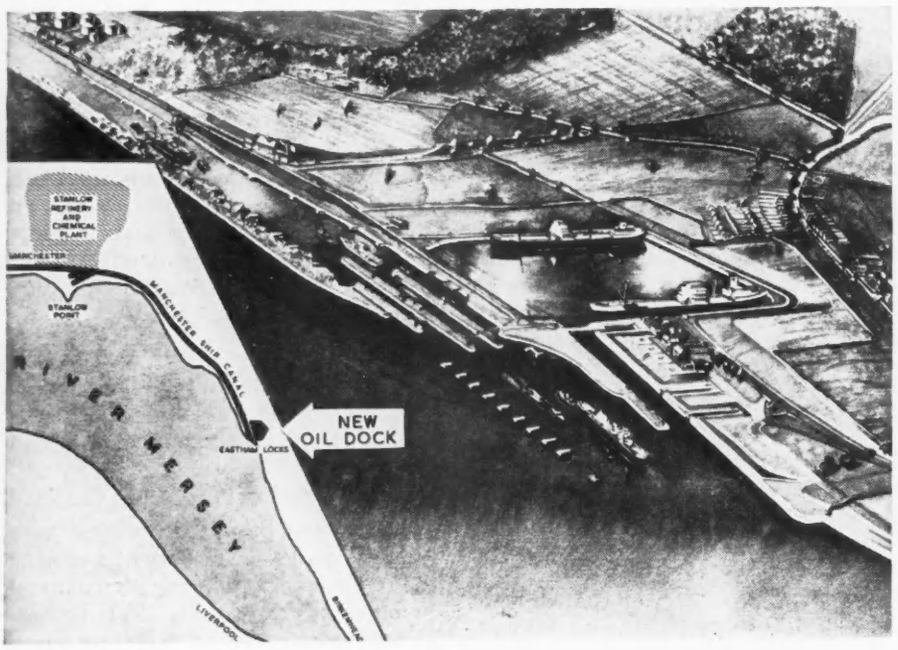
Born in Cando, N. D., he attended the University of Wisconsin, and in 1923 graduated from Stanford University as a geological economist. He is married and has two children.

OIL men traveling to Mexico will be interested in a new section of the AIME formed there. Luncheon meetings are held on the first Monday of each month at the American Club in Mexico city and AIME members are extended an invitation to attend when they are in the city. Anyone wishing to sit in should contact William G. Kane, secretary-treasurer, whose post office address is Apartado 711, Mexico City, and whose street address is San Juan de Letran Number 9, Desp. 805, phone 10-27-24. Officers of the section are Alfredo Terrazas, chairman; Valentin Garfias, vice chairman; and William G. Kane, secretary-treasurer.

In connection with this new section AIME announced a regional meeting for Mexico City from October 28 to November 3.

UNIVERSITY OF MICHIGAN LIBRARIES

Work Begins on Britain's Largest Oil Tanker Dock; Completion Set for 1952



Panoramic view of how the oil dock will look when completed as well as its location with relation to the Mersey River and the Stanlow refinery.

—Shell photo.

This view shows the area to be excavated for the entrance lock of the new oil dock in Britain. Concrete mixing has begun with the machinery seen in the left background. The conveyor belt system which removes the dirt from the bottom of the excavation can be seen in the center.

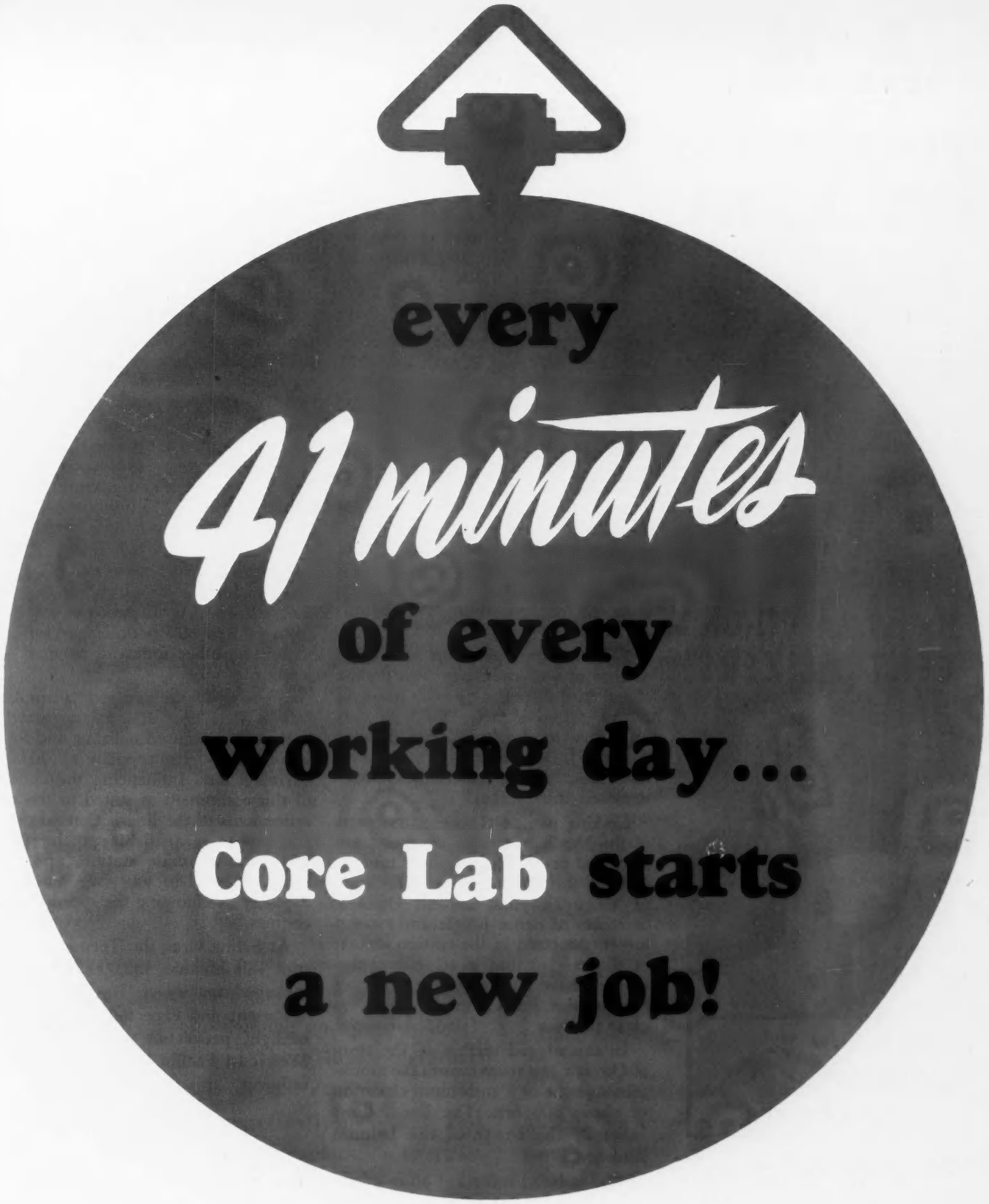
THE largest oil dock in Britain is being built at Eastham, Cheshire, where the Manchester ship canal joins the estuary of the Mersey River. When completed in 1952 the dock will accommodate four 28,000-ton tankers.

Although still in the excavation stage, a labor force, approaching 500 in number and likely to be almost doubled, has already removed 600,000 cubic yards—about one-sixth of the total task—and concreting of lock-gate camber walls is about to begin. Work is proceeding 24 hours a day, and has been spurred by the knowledge that three of Shell Oil Company's new fleet of giant tankers, which will use the new dock, have already been launched.

The Manchester Ship Canal Company realized in the immediate post-war days that oil tanker traffic was building up so rapidly that entirely new facilities were needed. Taking into account that Shell had placed orders for super-tankers, each of 28,000 deadweight tonnage, and that this oil company was embarking on large-scale development of the Stanlow refinery area, beside the canal, an oil dock of exceptional size was clearly required. Eastham was selected as the site.

The final design for the dock provides four berths in the form of a square with sides of 900-foot length, each berth accommodating a tanker of 28,000 or even 30,000 deadweight tons. The dock will cover 18½ acres, and is designed for 40 feet of water. From each berth, discharge facilities of the most modern type will feed a 16-inch diameter pipe line system to be laid over the seven miles along the canal bank to Stanlow. Shell is to erect a new tank farm for storage a short distance outside the dock area.

Entry to the dock will be by a lock 800 feet long and 100 feet wide. The three lock gates, or caissons, will be in effect huge hollow steel boxes, and will be towed by sea to Eastham from shipyards at Barrow-in-Furnace, Lancs. They will be sliding gates operated electrically, unlike the present Eastham locks, which employ miter gates moved hydraulically. Also included in the scheme is a large new building for the administrative offices of the Manchester Ship Canal Company.



"Providing more reservoir revenue . . . through the production of more recoverable oil."

UNIVERSITY OF MICHIGAN LIBRARIES

B and W SCRATCHERS AND CENTRALIZERS FOR A GOOD CEMENT JOB

B and W NU-COIL SCRATCHERS

Both are HINGED for quickest, easiest money-saving installation anywhere!

B and W LATCH-ON CENTRALIZERS

with the NEW KON-KAVE BOW

Strongest, Safest and Easiest to Install!

B and W Incorporated

* Well Completion Specialists *

WEST COAST — 3545 Cedar Avenue
Long Beach 7, California, Long Beach 4-8366
GULF COAST — P. O. Box 5266
Houston 12, Texas, Phone: WEntworth 6603

Mexico's Coast-to-Coast Line to be Ready in May

THE only coast-to-coast oil pipe line in the Americas will be completed by Petroleos Mexicanos in May, across the Isthmus of Tehuantepec, to provide safe and economical movement of oil products from east to west.

The ten-inch diameter, 155-mile line will transport gasoline, kerosine and diesel oil from Minatitlan, refining center on the east coast, to a terminal at the port of Salina Cruz for supply of Mexican west coast points.

The Isthmus line is designed to handle 15,000 barrels of refined products daily when it is first put into operation. Later, when a projected refinery on the west coast is built, the line will be converted to transportation of crude at the rate of 30,000 barrels a day. The additional capacity will be obtained by the addition of a pumping station midway of the line.

"The Isthmus pipe line will bring savings of well over a million dollars a year in transportation costs and will release approximately 200 tank cars for other service," declared Senator Antonio J. Bermudez, director general of Pemex. "It will materially improve domestic distribution."

Linking two ports where the coasts of the North American continent are in closest proximity, the line's route is through the southern part of the state of Veracruz and eastern Oaxaca. Stretches of dense jungle and swamp are encountered in the eastern section of the line, so that in some instances workers have resorted to the primitive tool of the jungle, the machete, to clear the way.

In the rugged terrain of the state of Oaxaca, the route crosses the mountainous zone at a maximum elevation of about 800 feet. The line follows generally the route of the Isthmus Railway.

The railroad route has afforded direct transportation of men, materials and equipment in building the line. It also offers ready facilities for operation and maintenance of the line, and its right-of-way and bridges are at the disposal of the pipe line.

Three alternatives were considered by Pemex in determining the size and the most advantageous use of the pipe line. Its possible uses were (1) to transport crude oil in substantial volume mainly to meet export needs (2) to transport crude oil in lesser amounts to supply domestic consumption and (3) to transport refined products for domestic consumption.

The ten-inch line was selected as a compromise solution, which would permit the line to be operated as a products line in the first stage of the project, and to be converted for crude oil transportation when a refinery is built on the west coast.

Only one pump station, at Minatitlan, will be used for the products line. It will have two reciprocating 15,000 barrels per day duplex pumps, operated by two 255-315 horsepower 270-330 revolution per minute diesel engines.

Only one of these units will be operated, to handle up to 15,000 barrels daily of products, at pressures varying from 600 to 800 pounds per square inch. The other unit will be used as a spare.

When crude is pumped, a similar station will be built approximately halfway between Minatitlan and Salina Cruz to give capacity of 30,000 barrels a day. Influencing the choice of this equipment as suited to the requirements of the line is that no electric power is available at the projected intermediate station, and the control given in varying pumping capacity by changing the speed of the engines.

At Salina Cruz the Terminal facilities will include 430,000 barrels of tankage capacity.

Present and expected consumption of light petroleum products on the Mexican Pacific Coast is shown as follows:

	(In barrels per day)	
	1950	**1955**
Gasoline	4,300	6,000
Kerosine	1,500	4,500
Gas oil	3,300	4,500
TOTAL	9,100	15,000

The pipe line, estimated to cost $3,427,000 (U.S.), is being constructed by a private contractor: Compania Constructora El Aguila, S. A. This company participated in building a part of the recently completed 280-mile, 12-inch diameter line from the Poza Rica oil fields to Pemex's new refinery at Salamanca.

Speed THIS EXPLORATION STEP!

All exploration comes at last to this—the slow and rugged job of collecting facts on the ground. It's the essential step.

But today footslogging *follows* aerial exploration. Now ground crews are directed to the *most promising* areas by photo-mapping and precise aerial magnetic surveys, and there make detailed studies. Thus the difficult and expensive ground survey is expanded in effectiveness and reduced in cost, and the whole exploration effort is greatly speeded.

Aero Service, a pioneer in airborne magnetometer surveys, cuts schedules from years to weeks or months . . . and does the work at a fraction of the cost of ground surveys. AERO's magnetic intensity records are accurate within 1 to 2 gamma—a precision resulting from AERO's more than a quarter million miles of aerial exploration.

Discuss your exploration problems with AERO. Let us help you direct your ground surveys to areas of greatest interest. Our worldwide mapping experience is unparalleled.

TOPOGRAPHIC MAPS • PLANIMETRIC MAPS
PRECISE AERIAL MOSAICS • AIRBORNE MAGNETOMETER SURVEYS
RELIEF MODELS • COLOR PHOTOGRAPHY

AERO
SERVICE CORPORATION
236 E. COURTLAND ST., PHILA. 20, PA.
Oldest Flying Corporation in the World

RUGGED— ACCURATE— EFFICIENT!

#3480
100 C.C.
CENTRIFUGE

You can maintain your required speed for the full period of the test with much less effort. Curtin centrifuges, proven world-wide, are heavy duty, rigidly constructed, and extremely simple in design. Illustrated bulletin, giving full details, available upon request.

W·H·CURTIN & CO.
HOUSTON .... NEW ORLEANS.

Maximum Restrictions Mean Minimum Oil, Says Suman

CONDITIONS which will encourage U. S. oil firms to invest in foreign development were outlined by John R. Suman, vice president and director, Standard Oil Company (N. J.), before the American Chamber of Commerce of Rio de Janeiro.

Brazil has depended upon Venezuelan and American crude oil and products to satisfy domestic demand in the past, and in many respects this could be a tremendous disadvantage in times of crisis, according to Suman. He reminded that various barriers now exist in Brazil's oil supply line which could become insurmountable at a time when Brazil is most in need of oil. Aside from currency restrictions and political barriers, a world crisis would divert tankers to more critical areas. As an alternative Brazil should seriously set out to develop oil production in the vast sedimentary basins already known to exist in the country.

Suman indicated that where the Brazilian oil agency has spent millions of dollars in the past 11 years to develop the country's present reserves of 26 million barrels, many more millions would have been spent and more oil probably found if restrictive legislation had not kept private oil companies from joining in the search.

"My company, together with many other companies in the American oil industry, has taken part in the search for oil in many countries around the world for many years," he said. "This experience has brought home to us the conviction that if the world is to produce the oil it can and should, the long-range outlook toward the oil business should not be one of increasing restrictions, but of reducing them so as to increase activity in the business and increase thereby the benefits flowing not only to the country of origin but to all with whom the country deals.

"Today, however, a tendency is apparent in many countries to limit activity. These restrictions are based upon a conviction that a nation having oil should itself benefit to the maximum from this resource. No one will seriously dispute that conviction, but there may be room to question whether in the long run a policy of restriction will actually lead to maximum benefits for the nation owning the oil. There is a great deal of evidence that this is not, in fact, the case.

"It may appear, for example, that the major benefit from oil is lost to a country unless the commodity is produced and dealt in only by nationals of that country. The evidence does not support this. Oil is essentially an international commodity. Of the nations in the world only the U. S. (and possibly Russia) shows an approximate balance of production and consumption. The other nations of the world either import oil to meet their own needs or export oil to meet the needs of others. Even the U. S. is today increasing the ratio of imports to exports to keep its internal oil economy at the most efficient level. So the over-all oil industry of a nation cannot be considered strictly as an internal matter. Capital may need to be invested in one country to provide products neded by another. By this process both nations benefit. If either the exporting or importing nation attempts to get an unreasonable share of the value of the product, or puts obstacles in the path of this interchange, then in the long run both will suffer.

Benefits of Competition

"Still another factor to be considered by a nation is the benefit which can be brought to any country by competition in a worldwide business. The result of the active competition in the business of oil has been more and better petroleum products at continually lower costs, delivered with greater convenience to all consumers. For any nation to close the door to competition is to deprive its own citizens of developments elsewhere that may be of important benefit to them. Charles Kettering once said, with reference to research laboratories, that when the door is closed to keep discoveries to one's self, much more is locked out than is kept in. I think the story is much the same with reference to the development of oil. Nations who close their doors in this field will find they have kept out far more than they have kept in.

"It is interesting to note that over

94 percent of the world's proven oil reserves have been found in those countries that have minimized restrictions and have permitted foreigners as well as nationals to compete in the search for oil.

"We are often inclined to discuss this idea of the proper investment climate sought by American business in foreign countries without becoming too specific about just what we mean. We use broad terms such as free enterprise and free competition which, I am afraid, are often misunderstood or not understood at all by the people of these countries. Because of this, I would like to outline a little more specifically some of the general conditions that we feel should prevail, what foreign capital may reasonably expect, and what a foreign government may expect in return.

"The assurances which American citizens have usually sought from a foreign government in undertaking the development of oil resurces under a concession from that government are:

"1. Security of title to the property or rights acquired.

"2. Managerial control of their own operations and

"3. The opportunity to make a reasonable profit from the enterprise.

"Given these assurances, concession contracts may take a variety of forms and local capital may be admitted to the enterprise if it desires to participate.

"The foreign government which lets concessions to private individuals or companies will properly insist:

"1. That an adequate participation in the proceeds from the enterprise come to the government;

"2. That operations shall be so conducted as to contribute to the domestic economy of the nation;

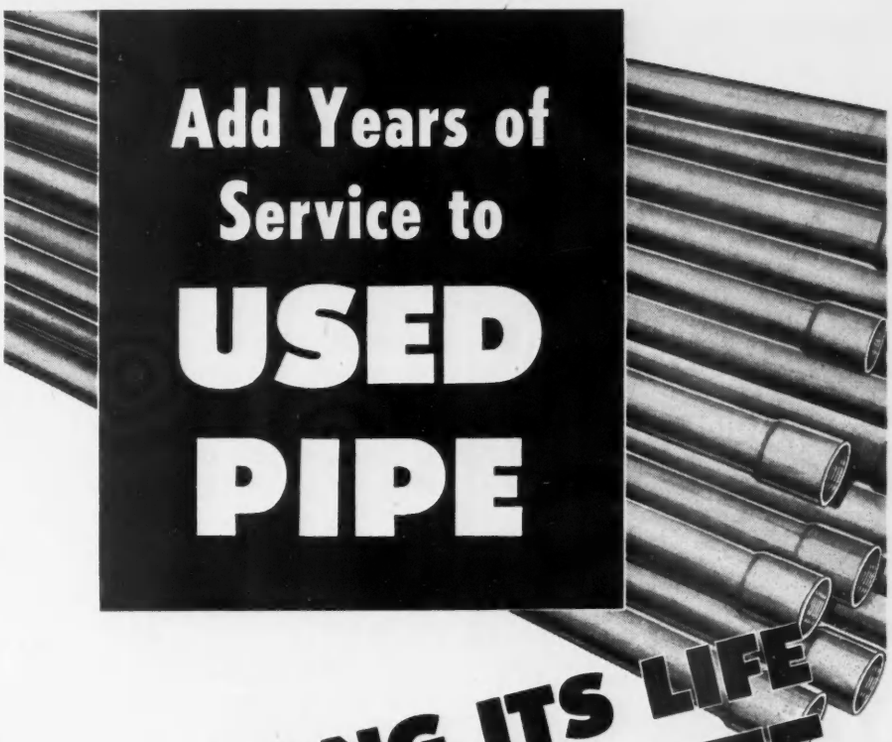
"3. That domestic demands for oil be fully satisfied at low prices before any oil is exported;

"4. That development and production proceed in an orderly manner with no avoidable waste of the natural resource;

"5. That the enterprise give to local citizens the maximum of training and employment at fair rates of compensation; and

"6. That oil and oil products available for export move to market in fair volume at fair prices.

"The satisfaction of these two sets of conditions seems to be basic to any operating agreement between a foreign oil operator and a nation. Once agreement on these conditions is reached, further details can probably be worked out with little difficulty."

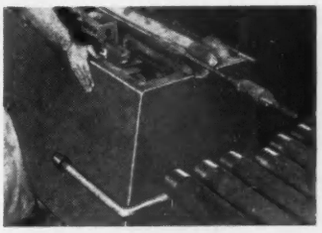


Add Years of Service to USED PIPE

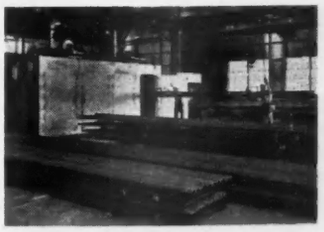
PROLONG ITS LIFE WITH TUBE-KOTE

PREVENTS TROUBLE ON THE INSIDE!

It is often possible to greatly increase the life and usefulness of old oilfield pipe by using the Tube-Kote plant-controlled process. This proven method of cleaning and coating with "T K-2" thermo-setting (baked-on) plastics assures a tough, extremely durable protective coating on the inner surfaces of oilfield tubular goods. Prevents corrosion from the inside, ends paraffin deposition, eliminates many costly "shutdowns" due to pipe failures.



Tube-Kote fully automatic internal coating unit applies a carefully controlled film of "T K-2" plastic in each coating operation.



A view of the Tube-Kote baking ovens which can handle over 12,000 feet of tubular goods per hour.

TUBE-KOTE

TUBE-KOTE

First Name In Corrosion Resistance

2520 HOLMES ROAD . . . P. O. BOX 8123, HOUSTON, TEXAS

WIRE, PHONE OR WRITE FOR TUBE-KOTE TECHNICAL SERVICE BULLETIN

UNIVERSITY OF MICHIGAN LIBRARIES

Why pull the well so often?

Use DARCOVA composition valve cups, seating cups and rings

The Original composition valve cup *still the best!*

YOU'LL SAVE MONEY BECAUSE..

• Precise control of all materials and processes from lab to well means exceptional resistance to wear and deterioration . . . fewer pulling jobs! • Different textures, scientifically developed, fully proved, give peak efficiency and longer flex-life at *any* depth! • Precisely controlled sizes for any make or size pump . . . no misfit inefficiency! • Ask for genuine Darcovas at your supply store.

DARLING VALVE & MANUFACTURING COMPANY

DARCOVA ®

THE ORIGINAL COMPOSITION CUP

WILLIAMSPORT 7, PA.

Montevideo and The Hague Are Sites of Oil Sessions

International oil men will interchange ideas at the Third World Petroleum Congress at The Hague, Holland, and the First South American Petroleum Congress at Montevideo, Uruguay.

Meeting from May 28 to June 6, 1951, The Third World Petroleum Congress will hear about 300 papers on geology, geophysics, drilling and production, oil processing, petrochemistry, petroleum measurement, control, analysis and testing, utilization of products, construction, materials, transport, storage and economics. About 40 percent of the papers will stem from the U. S.

Separate section meetings will be devoted to propagation of seismic wavelets, secondary recovery, tectonic and gravity features of the Far East, sulfur removal by extraction, platforming, economic prospects of petrochemical industries, detergents from petroleum, measurement and sampling of crude oil, oil constitution, fuels for turbine engines, economics of modern refinery plant layout and automatic control of pipe line stations.

The First South American Petroleum Congress is set for March 12-16, 1951. Meeting in Montevideo, the congress is expected to be the largest ever held in South America for petroleum technicians, scientists and production men. Sponsored by the South American Petroleum Institute, the congress will extend invitations to all government and private institutions in the U. S. engaged in oil activities.

Chief purpose of the meeting will be to consider the best means of increasing production of oil and its by-products in South America, study the economics of oil production and by-products, and promote the exchange of oil products and technical ideas between the countries of Latin America. Technical papers will be presented on a variety of topics encompassed by geology and petroleum exploration, petroleum production, chemistry of petroleum, refining, transportation and storage, consumption and utilization, supply, economics of the petroleum industry, and training programs.

Gulf Agrees on Sale of Mexican Oil Properties

Gulf Oil Corporation has agreed to sell its Mexican oil properties to that country's government. Details had not been concluded and the actual sales contract not signed. The properties, a Gulf spokesman said, have not yielded any net return for a number of years. Production during 1950 was less than 1300 barrels per day.

Gulf's first production in Mexico came in during 1913. Originally crude produced by the company's wells there was refined at its Port Arthur, Texas, plant. However, since about 1940 all sales of crude oil produced have been made to the Mexican government.

Germany's 1950 Oil Output Tops 7.8 Million Barrels

With production in excess of 7.8 million barrels, Western Germany recorded its highest oil production in 1950. The only previous year that approached this figure was 1940 when nearly 7.4 million barrels were produced. Last year's output nearly doubled that of 1945, the year the war ended, and was 32 percent greater than 1949 production.

The big factor in the 1950 production was the Emsland district, near the Dutch border, where production exceeded 3.5 million barrels. This rapidly developing oil area now has reserves of 187 million barrels and is considered Germany's top oil region. The Hanover oil fields were moved down to second place last year for the first time with production of about 3.4 million barrels.

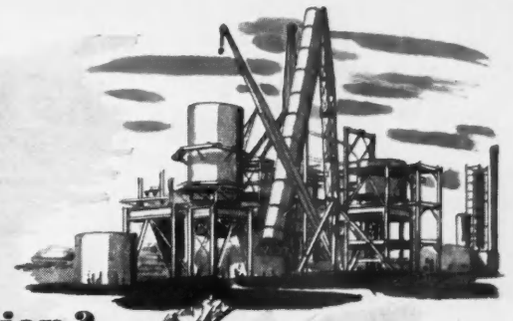
Germany's progress in oil is attributed to systematic development of fields found shortly before and during the war, and intensive wildcatting in the past two years which added new areas of production near the older fields.

Anglo-Iranian Completes Bridge Over Karun River

An important feature in the development of the Anglo-Iranian Oil Company's newest oil field in Lali, Iran, northwest of Masjid-i-Sulaiman, has recently been completed. This is the new steel bridge across the fast-flowing Karun River which bisects the field.

Operations at Lali, which began regular production in 1948 after many years of difficult exploration work, have been to some extent handicapped in the past by the lack of an easy river crossing. Since 1945 the company has made use of a transporter bridge. The only other method of crossing was by local craft, which could not be used during the flood season.

The new bridge is 547 feet long and 100 feet from road level to the base of the foundation of the longest pier. Its largest span is 170 feet. It is designed for a standard load of 30 tons. The width is 17 feet, comprising a 12-foot carriageway and 5-foot footway.



Winter planning for spring construction?

To help you in your winter planning for spring construction, Fluor offers this list of process responsibility. It is a reflection of the broad experience accumulated through over thirty years of design, engineering, and construction of plants and facilities for the oil, gas, chemical, and power industries.

Whatever your plans include—a completely integrated plant or the expansion of existing facilities—Fluor's background knowledge of the problems peculiar to these industries is at your disposal. Fluor can help you. Contact our nearest representative for prompt attention to your individual requirements.

FLUOR

Fluor **can help**

in the Design, Engineering and Construction of . . .

GASOLINE PLANTS

- Natural Gasoline and LPG Recovery
- Combination H_2S Removal and Dehydration
- H_2S Removal
- Dehydration

REFINING & PETROCHEMICAL PLANTS

- Catalytic Cracking
- Sulfuric and HF Alkylation
- Hydrogenation
- Catalytic Polymerization
- Catalytic Isomerization
- Thermofor Pyrolitic Cracking
- Crude Distillation and Stabilizing
- Absorption and Fractionation of Refinery Gases
- Vacuum Units of All Types
- Thermal Reforming
- Thermal Cracking
- Crude Coking
- Low Temperature Fractionation of Hydrocarbons
- Hypersorption
- Lube Oil Dewaxing
- Lube Oil Solvent Extraction
- H_2S Removal

FOR YOUR OFFSITE FACILITIES

Experienced Fluor Engineers, together with permanently employed Fluor key construction personnel, are available to handle any or all Offsite Facility work necessary for successful on-stream operation of refineries, gas-gasoline plants, chemical plants, and power plants.

BE SURE WITH FLUOR

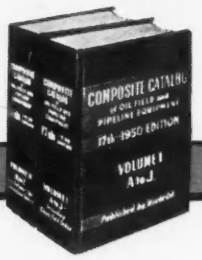
DESIGNERS AND CONSTRUCTORS of Refining, Natural Gas and Chemical Processing Plants.
MANUFACTURERS of Pulsation Dampeners, Mufflers, Gas Cleaners, Cooling Towers and Fin-Fan Units.

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, Calif. Offices in principal cities in the U.S.A.
REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Baltic St., London, E.C.I., England

UNIVERSITY OF MICHIGAN LIBRARIES

NEW AND IMPROVED EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG



Hydraulic Jar

This item supplements M. O. Johnston Oil Field Service Corporation data on pages 2570-2592 of Composite Catalog, 17th Edition.

The Johnston-Sutliff Hydraulic Jar is operated hydraulically by means of lubricating oil which fills completely the annular space between the mandrel and the outer housing, thereby eliminating mechanical tripping. The jar delivers a continuous series of blows over any necessary period of time with simple manipulation at the surface. The jar itself requires no rotation for its operation, but being keyed against rotation of the mandrel within the housing, it provides for the rotation of any equipment below when such rotation is necessary for operation of the equipment or for backing off to right or left below the jar. In addition to being particularly adaptable for use with the Johnston Formation Tester, this jar is effective for fishing jobs. It is operated by merely raising and lowering the string. The jar is stronger than any part of the drill pipe on which it is run.

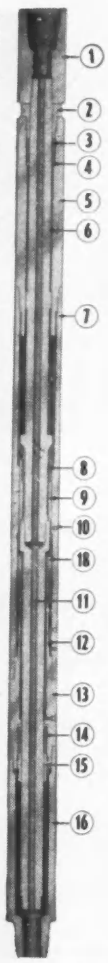


Fig. 1

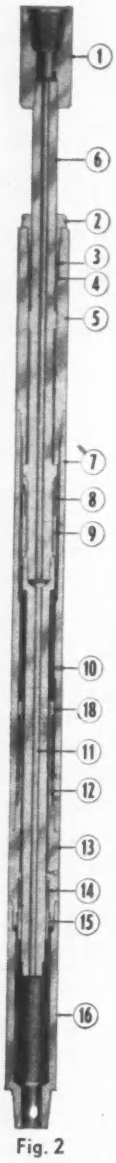


Fig. 2

The jar requires no setting or resetting. The intensity of the blow is governed by raising the pipe until the desired weight is indicated on the weight indicator. When the string is raised, a tension approximately equal to the amount shown on the weight indicator is placed on the mandrel and causes it to rise. As the piston, which is an integral part of the upper mandrel, is pulled up through the restricted area in the valve housing, pressure on the oil above the piston is increased. This forces oil down through the clearance between the piston valve and the restricted area of the valve housing and into the annular space below. The pressure is maintained in balance by the hydrostatic pressure of the well fluid.

Because the clearance is small, the piston moves slowly until the bottom of the piston valve reaches the enlarged area of the housing. When it reaches this point, the piston is free to move without restriction and is suddenly jerked upward by the tension in the string, causing the hammer to strike the anvil, as shown in Figure 2.

When the string is lowered, the piston valve opens and allows the oil below the piston to flow freely through the by-pass channels into the annular space above, permitting the jar to return unrestricted to "set position" (Figure 1).

Numbered parts illustrated are 1. top sub, 2. upper packing unit, 3. upper packing, 4. packing support ring, 5. key sub, 6. upper mandrel, 7. valve housing, 8. valve spring, 9. piston valve, 10. pipe plug, 11. lower mandrel, 12. seal ring, 13. lower packing sub, 14. lower packing, 15. lower packing nut, 16. bottom sub.

For additional information, write M. O. Johnston Oil Field Service Corporation, 3035 Andrita Street, Los Angeles 65.

Shackle

This item supplements George E. Failing Supply Company data on pages 1581-1600 of Composite Catalog, 17th edition.

A new type of shackle for use with wire lines provides high safety factors. Because of its simple design, the shackle can be positively opened or closed even in the dark. Cotter pins have been eliminated.

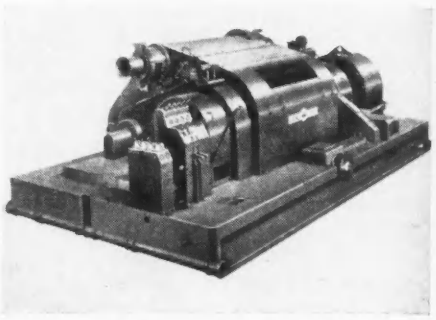
For additional information, write George E. Failing Supply Company, Enid, Okla.

Save Time—Write Direct

As a service to readers, all items in WORLD OIL include the complete mail address of the manufacturer. This makes it possible for those desiring additional information to write any manufacturer without the delay occasioned by going through offices of WORLD OIL, and enables subscribers to request specific data in which they are particularly interested.

Drilling Rig

This item supplements The National Supply Company data on pages 3433-3564 of Composite Catalog, 17th Edition.



The Ideal Type 130 Consolidated Rig is normally considered for drilling in the 12,000- to 15,000-foot depth range.

Included in the rig is a new drawworks designated as the Type 130 and an Ideal Type "B" sectional drive group which may be selected from a range of three and four engine drive groups suitable for use with 6 or 8-cylinder engines in the 300 to 400 hp class. The drawworks is rated at 1300 input horsepower. It provides six forward hoisting speeds, three rotary speeds, and three catshaft speeds. Two reverse speeds are provided for the hoisting drum, one reverse speed for the rotary machine, and one reverse speed to the catshaft.

The large grooved hoisting drum, 30-inch diameter by 56¼ inches long, was designed primarily for 1⅜-inch line. The drum is long enough to permit hoisting 120-foot stands with eight lines without spooling more than three full layers of line.

The drum shaft has large integrally forged flange sections where the drum hubs are supported with press fits.

Ideal compound equalizing brakes on the drum are 54 inches in diameter and 10⅜ inches wide. The auxiliary brake may be either a Dynamatic or Hydromatic, connected to the drum shaft by means of a gear tooth disengaging-type coupling and hand operated at the brake position. An optional coupling arrangement with the Hydromatic brake is an "over-running" clutch which automatically disengages the brake when hoisting the empty blocks.

High-speed drum drive air clutch is an Ideal 40 x 10-inch Dy-A-Flex drum-type constricting clutch. The low-speed drum drive is applied through the Ideal 36-inch four-plate air clutch.

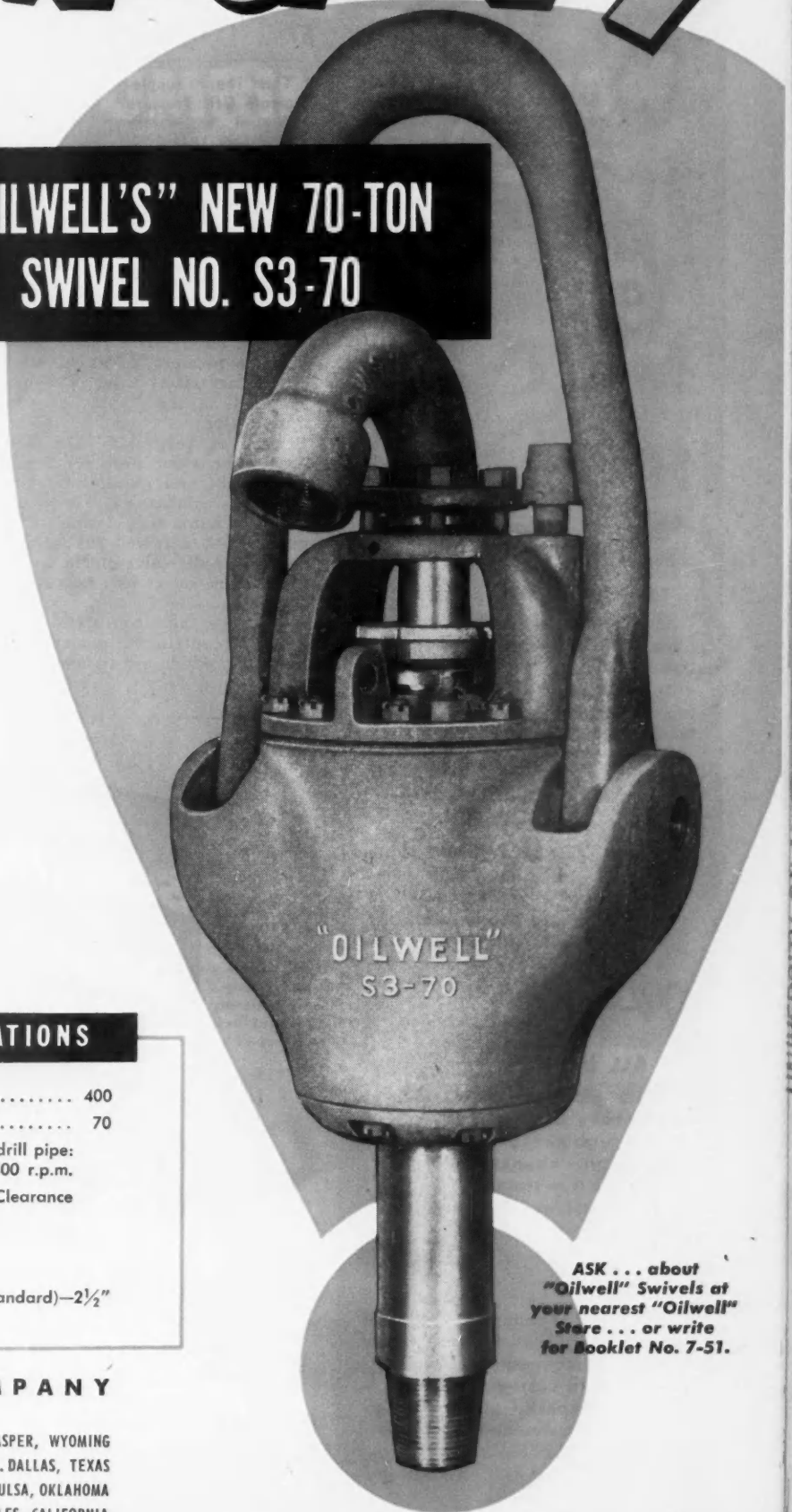
Drawworks transmission has a disengaging reverse gear. For driving a feed-off device, the jackshaft has been divided into a long transmission shaft and short countershaft.

For additional information write The National Supply Company, Box 899A, Toledo, Ohio.

SMALL BUT MIGHTY

NOW you can have a small "Oilwell" Swivel with many of the high quality features that have made "Oilwell's" heavy-duty swivels so outstanding. The No. S3-70 is designed for light duty and portable rig service. It extends your selection of "Oilwell" Swivels to *five*—with ratings of 70, 100, 200, 300 and 400 tons.

"OILWELL'S" NEW 70-TON SWIVEL NO. S3-70



HERE ARE ITS OUTSTANDING FEATURES

1. Heavy-duty main bearing—full apex tapered rollers with bronze spacer ring.
2. Hardened and polished wash pipe.
3. "Oilwell" grease-lubricated self-sealing wash-pipe packing—requires no adjustment.
4. Large radius gooseneck—reinforced and heat-treated.
5. Forged steel body and bail—heat-treated for extra strength and long life. (Pin type bail also available.)
6. Circulating oilbath—assures cooling and adequate lubrication of main bearing.
7. Shielded oil seal at top and grease-packed oil seal assembly at bottom of housing to prevent leakage.
8. Lubricated housing bail trunnions.
9. Widely spaced radial bearings with shim adjustment to assure proper running clearance.

BRIEF SPECIFICATIONS

Maximum Recommended r.p.m.	400
Dead Load Capacity tons	70

Maximum Recommended Drilling Depth with 3½" 15 lb. drill pipe: 6250' at 100 r.p.m., 5000' at 200 r.p.m., 4200' at 400 r.p.m.

Dimensions: Length overall 56¼", Width overall 20¼", Clearance between bail and gooseneck 10¼".

Body fluid passage bore 2⅛".

A.P.I.L.H. Tool Joint Pin Size 3½" full hole.

Gooseneck—has 3" A.P.I. female line pipe thread (Standard)—2½" thread (Special).

ASK . . . about "Oilwell" Swivels at your nearest "Oilwell" Store . . . or write for Booklet No. 7-51.

OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

Executive Office—DALLAS, TEXAS
Export Division Office—
30 ROCKEFELLER PLAZA
NEW YORK 20, N. Y.

Division Offices—CASPER, WYOMING
COLUMBUS, OHIO . . . DALLAS, TEXAS
HOUSTON, TEXAS...TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS TRADE MARK

"OILWELL" TRADE MARK

UNITED STATES STEEL

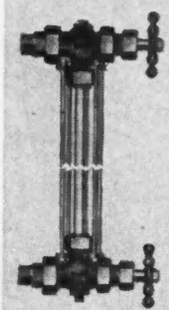
PENBERTHY
Liquid Level GAGES

REFLEX

Reflex type complete with gage valves. Liquid shows black—empty space shows white. Liquid level is always unmistakable.

TRANSPARENT

Transparent type complete with gage valves. Used where through vision is desired under high pressures and/or temperatures.

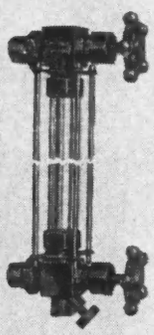


DROP FORGED STEEL

Tubular glass type, Chrome-Moly temperature resisting steel body, stainless steel trim, regrinding removable seats.

ALL IRON

Tubular glass type, extra heavy body of special high strength alloy iron, shanks alloy steel, trim stainless steel, valves self-cleaning.



There is a Penberthy Gage of superior quality for every liquid level gage requirement. Gages are fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. All Penberthy Gages conform with API-ASME requirements.

3277-B

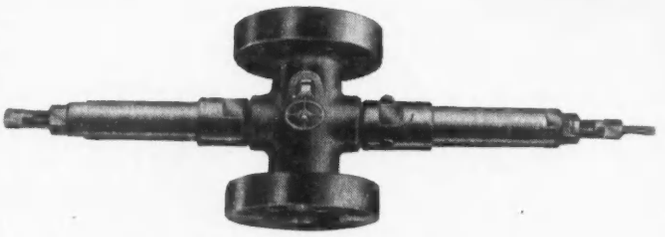
PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant — Windsor, Ontario

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Flow Line Safety Valve

This item supplements Otis Pressure Control, Inc., data on pages 3885-3920 of Composite Catalog, 17th Edition.



A new automatic pressure-operated surface safety valve for high- or low-pressure flow lines combines certain features of the Otis removable tubing safety valve and the high- and low-pressure pilots of the Type X otis surface safety valve. The new valve is identified as the "Type A" Otis surface safety valve.

Type A valve utilizes the pressure within the valve bore for the energy to close itself, and requires no outside lines for most installations. To open the valve after an automatic closing (1) close the pilot which actuated the valve, and (2) crack a needle valve on the by-pass, which opens the valve by means of pressure alone.

The new valve consists of a valve body, bored to contain an inner valve assembly, two pilots which are treaded into the body at right angles to the line of flow, and the by-pass valve which is opened to equalize pressure across the annular piston area.

A spring on the safety valve assembly holds the valve open against the frictional force set up by the flow. Pressure existing within the valve body also is exerted into the annular spring chamber through two small ports. The annular section is closed at the downstream end by a stationary packing section, and at the upstream end by O-ring packing on the piston. The pilots, connected to this chamber, are subjected to the same pressure existing in the bore of the valve. The by-pass is closed off by means of the needle valve assembly. When pressure within the valve bore rises to a figure considered unsafe, the

... another reason why drillers prefer

Standco
NO-SMOKE
BRAKE LINING

Standco Brake Blocks are made of cabled cords of long fibre asbestos — woven solid and reinforced with bronze wire to prevent pulling loose on the bolts. They will not burn or smoke or score brake rims.

More deep wells have been drilled with Standco than with all other blocks combined. It's your answer for low-cost hole-making.

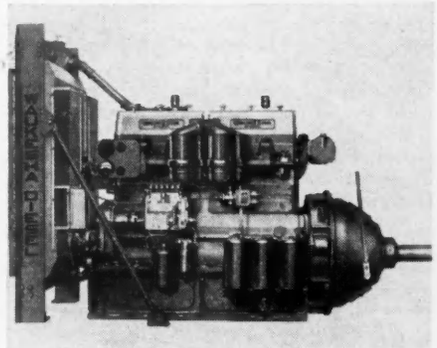
STANDCO BRAKE LINING COMPANY
Factory and General Offices
2701-2801 Clinton Drive — Houston, Texas

high-pressure pilot opens with a snap action to release the pressure from the annular spring chamber to atmosphere. Similarly, if pressure on the line drops to a point below any normal surge (indicating a large leak or an actual break) the low-pressure pilot opens to release the pressure in the spring chamber. The "differential pressure" across the annular piston causes the safety valve to move to the "closed" position, against the force of the spring. When the valve is closed, the differential pressure acting against the full seat area, which is even greater than the annular area of the piston, holds the valve tightly closed.

For additional information write Otis Pressure Control, Inc., Box 7206, Dallas.

Six-Cylinder Diesel

This item supplements Waukesha Motor Company data on pages 4914-4915 of Composite Catalog, 17th Edition.



A new Waukesha diesel power unit, the Mogul Six, of 1905-cubic inch displacement, carries a maximum continuous output rating of 201 horsepower with overload capacity of 272 hp.

The Mogul Six is a six-cylinder, four-cycle, solid injection full diesel with a bore of 7 inches and a stroke of 8¼ inches. It has the spherical combustion chamber characteristic of all Waukesha diesels, and is recommended for use with high speed diesel fuels of 45 octane or above.

A conversion kit is available to convert the engine in the field from diesel to natural gas, and vice versa, without any internal parts being changed.

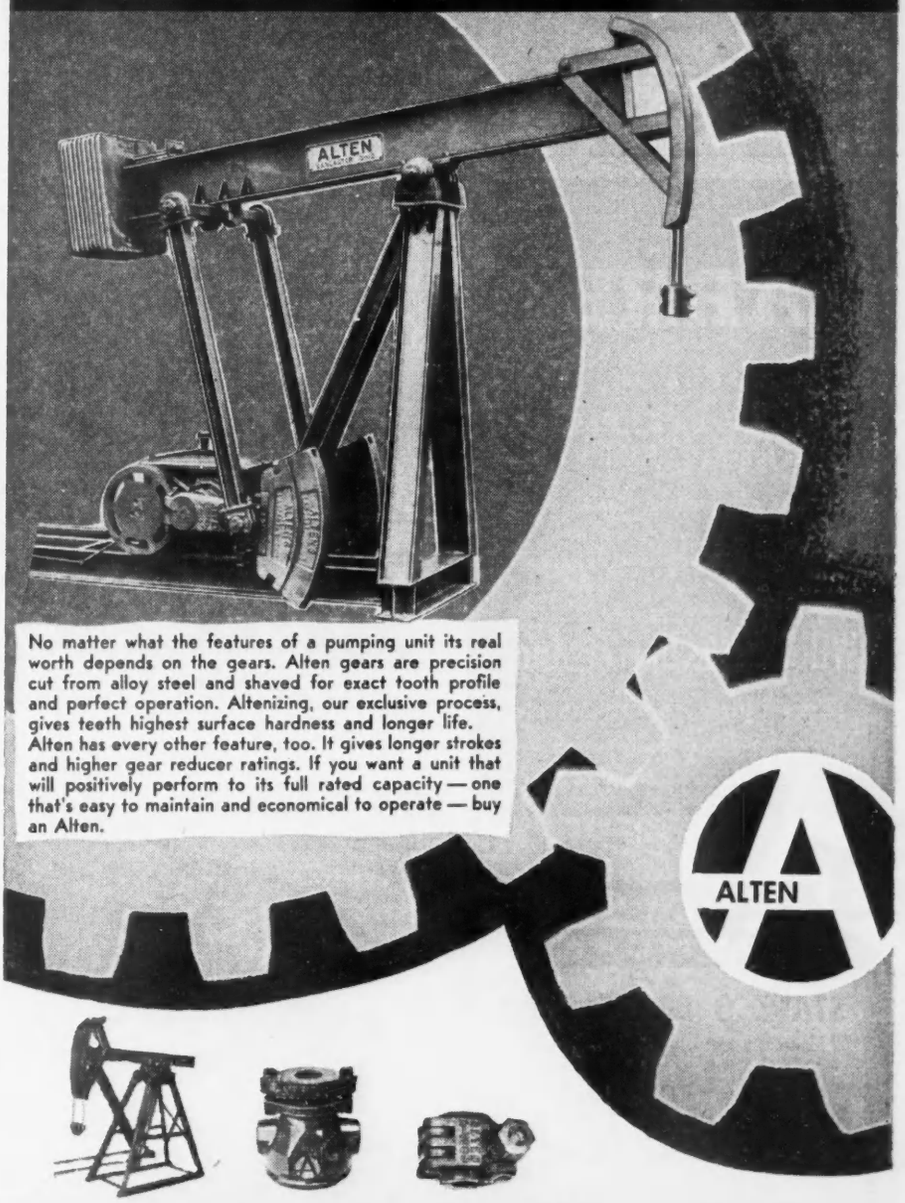
For additional information, write Waukesha Motor Company, Waukesha, Wis.

Order Your Copy of 1950 World Oil Index

The complete editorial index covering all issues of WORLD OIL published during 1950 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to all subscribers who write requesting copies.

Orders should be addressed immediately to the Circulation Department, Box 2608, Houston 1, Texas, as quantities are limited.

ALTEN
PUMPING UNITS ARE *Geared* FOR BEST PERFORMANCE



No matter what the features of a pumping unit its real worth depends on the gears. Alten gears are precision cut from alloy steel and shaved for exact tooth profile and perfect operation. Altenizing, our exclusive process, gives teeth highest surface hardness and longer life. Alten has every other feature, too. It gives longer strokes and higher gear reducer ratings. If you want a unit that will positively perform to its full rated capacity — one that's easy to maintain and economical to operate — buy an Alten.

PUMPING, SURFACE & FIELD EQUIPMENT

ASK FOR COMPLETE ALTEN LINE
AT YOUR LOCAL SUPPLY STORE

ALTENS FOUNDRY & MACHINE WORKS, INC.
LANCASTER, OHIO

UNIVERSITY OF MICHIGAN LIBRARIES

Red Top (Hydrostatic) BAILER

A QUICK, POSITIVE LOAD REGARDLESS OF FLUID LEVEL.
Ideal also for fishing small objects—widely used for drilling in (completing) wells, and for drilling cement or plastic plug overages.

REYNOLDS SPECIALTY COMPANY, INC.

SHREVEPORT, LOUISIANA, U. S. A.
Office: 804 Erie St., Phone 7-7511
If no answer call 2-2023, 7-4966, or 2-5842
Factory: 2134 Greenwood Rd., Phone 2-2023
COMPLETE INSURANCE COVERAGE

Louisiana:
HOUMA, Sam Hattaway, phone 6263 & 6731.
JENA, Germany Machine Co.
LAFAYETTE, Jack Willhoit, Phone 4662.
RODESSA, Republic Supply Co.
SHREVEPORT, Phone 7-7511

Arkansas.
EL DORADO, Cox Supply Co.

Oklahoma Service:
OKLAHOMA CITY, Dawson Service Co., Phone 54-7577

Texas:
CORPUS CHRISTI, A. S. Baylor, Phone 2-2461.
BORGER, Nichols Tool Company, phone 350.
KILGORE, Spain Brothers, phone 2981.
SERVICE, phone 3, Turnertown; 2981, Kilgore;
TALCO, Talco Lumber Co
SEMINOLE, A. C. Simmons, phone 404-J.

BARRET

SPECIALIZING IN MAGNETIC SURVEYS

Contracts accepted for domestic and foreign projects, using the most improved instrumental and interpretative technique.

William M. Barret, Inc.

Consulting Geophysicists

GIDDENS-LANE BUILDING
SHREVEPORT, LOUISIANA

Standco
NO-SMOKE

STANDCO BRAKE LINING

Nothing novel—no bunk, but it gets the job done without scoring brake rims. See pages 3973-3978 Composite Catalog.

Standco Brake Lining Co.
HOUSTON

HOUSTON LABORATORIES
Analytical and Consulting Chemists

Hydrocarbon Gas Analyses, Reservoir Equilibria Studies for Crude and Condensate well, Waters, Brines, Corrosion and Industrial Analyses.

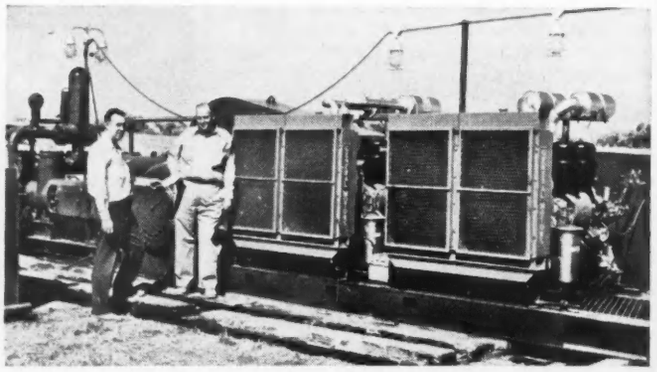
Phone CApitol 1319, Box 132, Houston, Texas

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Mud Pump Compound

This item supplements Detroit Diesel Engine Division data on pages 1366-1369 of Composite Catalog, 17th Edition.



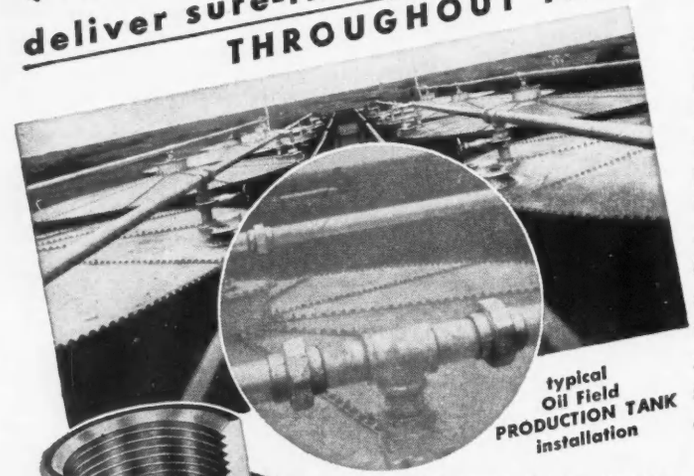
Flexibility of multi-engine internal combuston power units is demonstrated in a new mud pump compound which has a power plant consisting of two GM diesel "Twins."

The unit is an Ideal C-250 mud pump powered by one "Twin 4" and one "Twin 6" GM diesel engine. Because any one engine or any combination of engines in the two multiple units can be started and clutched in at will, diesel power is available at eight different cylinder combination—4, 6, 8, 10, 12, 14, 16 or 20.

Although operation may seldom call for the use of less than 10 or 12 cylinders, flexibility eliminates the necessity of idling an engine along with light loads or stalling it down with overloads. As the required mud pressures increase or decrease engines are clutched in or out. Any engine can be cut out for maintenance without shutting down the job. Over-all dimensions of the equipment are 96 inches wide by 30 feet 10 inches long.

For additional information write Detroit Diesel Engine Division, General Motors Corporation, 13400 West Outer Drive, Detroit 28.

CATAWISSA PERFECT SEAL UNIONS
deliver sure-fire piping dependability THROUGHOUT THE OIL FIELDS!



In high or low pressure, extremely high temperature or corrosive piping conditions, CATAWISSA HOT FORGED STEEL UNIONS are maintaining their long-standing reputation for sure-fire piping dependability!

CATAWISSA PERFECT SEAL UNIONS are designed and produced for dependable, long-life service under the severest piping conditions—made with hand ground seats that require no packing and feature Catawissa's Ball-To-Angle seat design which gives a PERFECT SEAL even when the pipe is not in alignment!

write or call for your copy of the NEW CATALOG 11 showing the complete CatawissaLine

stocked and distributed by

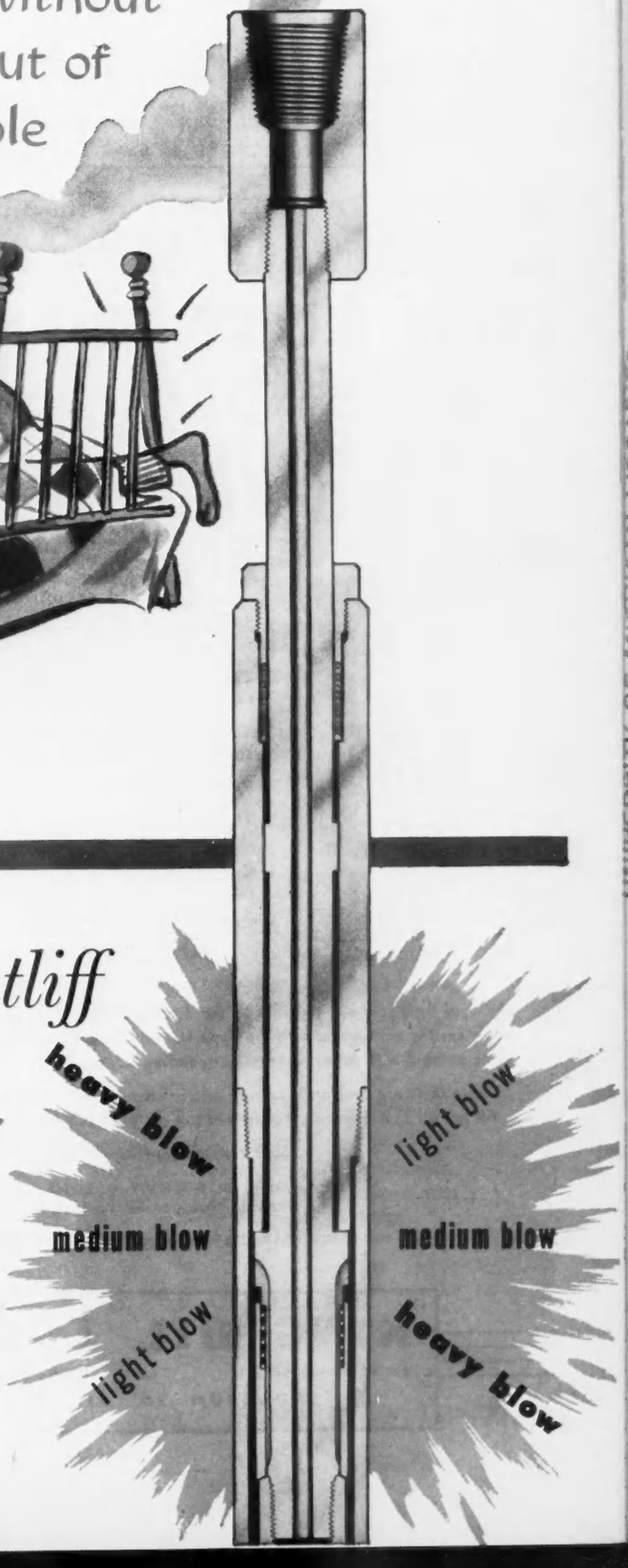
OIL WELL SUPPLY CO.
Branches Serving All Oil Fields

Catawissa Valve & Fittings Co.—Catawissa, Penna.

The driller's dream come true...*

A jar that hits any desired blow, at any time, to meet any condition-without pulling out of the hole

**Jarring Jerry*



The NEW *Johnston-Sutliff*

HYDRAULIC JAR

"The right jar for the job at hand"

Write For Descriptive Literature!

JOHNSTON

SHOOT TEST — JOHNSTON — FORMATION AND CASING TESTING

M. O. JOHNSTON OIL FIELD SERVICE CORPORATION
3035 Andrita Street—Los Angeles 65, California
"Servicing California & Rocky Mountains"

M. O. JOHNSTON OIL FIELD EXPORT CORPORATION
3035 Andrita Street—Los Angeles 65, California
"Exclusive Export Sales"

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Rotary Hose

This item supplements United States Rubber Company data on pages 4823-4831 of Composite Catalog, 17th Edition.

A new wire reinforced rubber and fabric rotary hose for high pressure oil well drilling operations is available.

Wire reinforcement together with fabric and rubber construction gives the hose the strength to withstand the pressures of the heaviest pumps in the oil fields while retaining the flexibility and kink resistance needed for efficient drilling operations.

The new hose designated U. S. Royal 4 rotary hose, will drill a well from top to bottom regardless of pump pressure required or gas pressure encountered. It eliminates the need for transferring from rubber to steel hose in high pressure operations.

For additional information, write United States Rubber Company, Rockefeller Center, New York 20.

Portable Drill

This item supplements George E. Failing Supply Company data on pages 1581-1600 of Composite Catalog, 17th Edition.

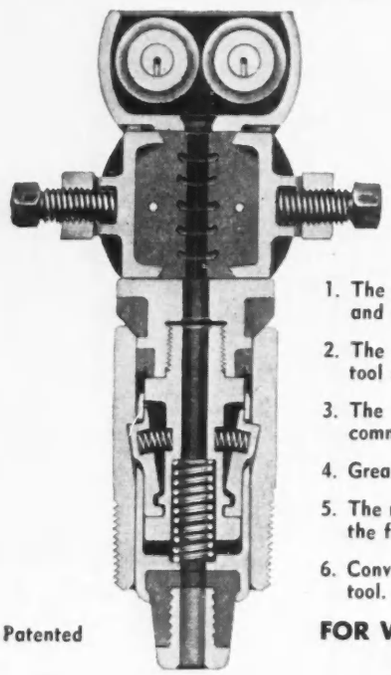
Designed for drilling in areas where boulders or loose unconsolidated materials predominate, the Failing 1500 Holemaster drill has an arrangement whereby the kelly is eliminated and drilling is accomplished by connecting the swivel directly to the casing.

The inside diameter of the drive rod is increased to 4¼ inches. This arrangement provides for the use of three-inch line pipe casing and allows sufficient clearance for the couplings.

Sections of casing are added as the hole is deepened, and it is unnecessary to make trips in and out of the hole. Attachments are available to convert the unit back to conventional drilling with the standard kellys.

For additional information, write George E. Failing Supply Company, Enid, Okla.

Low Maintenance
LOW COST—LONG LIFE



Patented

Be Sure IT'S A KING *Be Safe*

With A 3AR Wire Line STRIPPER FOR SWABBING TUBING

Type 3AR King Wire Line Stripper ("Oil Saver") is the ideal tool to use in connection with swabbing operations.

1. The positive latch and sure release insure against accidents and eliminate the possibility of jerking a wire line in two.
2. The packing is inserted from the sides of the tool and the tool can be repacked while the line is in the hole.
3. The roller line guides center the line; outlasts the more commonly used bushing many times.
4. Grease nipples are provided to lubricate the guide rollers.
5. The non-sparking materials used in its construction minimize the fire hazard.
6. Convenient hand holds contribute to easy handling of the tool.

FOR WIRE LINE CORING THE 4AR KING WIRE LINE STRIPPER IS WIDELY USED

The Type 4AR Stripper is similar to the Type 3AR, except it is a little larger. It is commonly used in connection with the Type 4C King Circulating Head. It can be, and sometimes is, used with other makes of circulating heads.

These tools are constantly coming into greater use. A trial is convincing.
All price F.O.B. Houston, Texas, and subject to change without notice.

Sold through your supply store

Export: **R. S. STOKVIS & SONS, Inc.**
17 Battery Place, New York 4, N. Y.

See your Composite Catalog for detailed description of other King Tools.

KING OIL TOOLS
210 TERMINAL STREET PHONE OSage 3-3421
HOUSTON 20, TEXAS

Save Time—Write Direct

As a service to readers, all items in WORLD OIL include the complete mail address of the manufacturer. This makes it possible for those desiring additional information to write any manufacturer without the delay occasioned by going through offices of WORLD OIL, and enables subscribers to request specific data in which they are particularly interested.

AT LAST REPORT, this string of "K" Monel sucker rods had been used continuously for 8 years in the Howard Glasscock Field at Big Spring, Texas. Before switching to "K" Monel, there was a rod break every 50 days, the entire string needed replacement every 5 months.

Corrosive wells can be operated profitably with equipment made of Monel® and "K"® Monel.

This has been proved time and again—even in the sour gas areas of West Texas and New Mexico.

It is easy to see why. Monel, for example, is strong and tough. It is highly resistant to corrosion by brine and sour crude. It withstands the cutting action of high pressure gas, and the abrasive effects of entrained solids.

"K" Monel has the same characteristics, coupled with the added advantages of even greater strength and hardness. It is non-magnetic. By heat treatment, its tensile strength can be developed to 140-170,000 psi, and its hardness to 265-320 Brinell.

These important facts about Monel and "K" Monel are helpful guides in . . .

Choosing the
RIGHT EQUIPMENT *for* CORROSIVE WELLS

THESE TWO BELLOWS were used in a gas lift valve in the same sour well. Photo at left shows condition of the best previous bellows after 19 days. Compare this with other photo, taken of a Monel bellows when it was removed for inspection after 141 days of use.

BALL AND SEAT VALVE of "K" Monel. At depth of 3,500 feet, pulsating 28,000 times a day, and subjected to the action of corrosive crude, one of these heat treated "K" Monel valves lasted 10 months, 22 days. Alloy steel valve in same well lasted only 21 days.

Both alloys are used for parts subject to alternating stresses in the presence of corrosives. Their retention of good fatigue strength is particularly evident in lengthened equipment life. Under varied conditions of temperature, pressure and velocity, Monel and "K" Monel stand up where other materials frequently *give* up.

Our illustrated booklet, ***Controlling Corrosion in Petroleum Production Equipment,*** tells how you can put Monel, "K" Monel and other INCO Nickel Alloys to work for you. It brings you the details of typical performance and service records like the three shown on this page. It contains individual sections dealing with exploration and drilling, pumping, and gas control.

The booklet tells, too, how you can get free technical advice on the selection of materials for severe service, and contains a listing of valuable bulletins and other literature that have been prepared for your use. Write us—*now*—for your copy. No obligation.

• • • •

MILITARY NEEDS COME FIRST

Although Nickel and Nickel Alloys are currently in short supply, Inco advertisements will continue to bring you information on products, developments, and applications that we believe will be of interest.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE
INCO
TRADE MARK

MONEL . . . "K" MONEL . . . YOUR PARTNERS IN PROGRESS

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Protective Coating

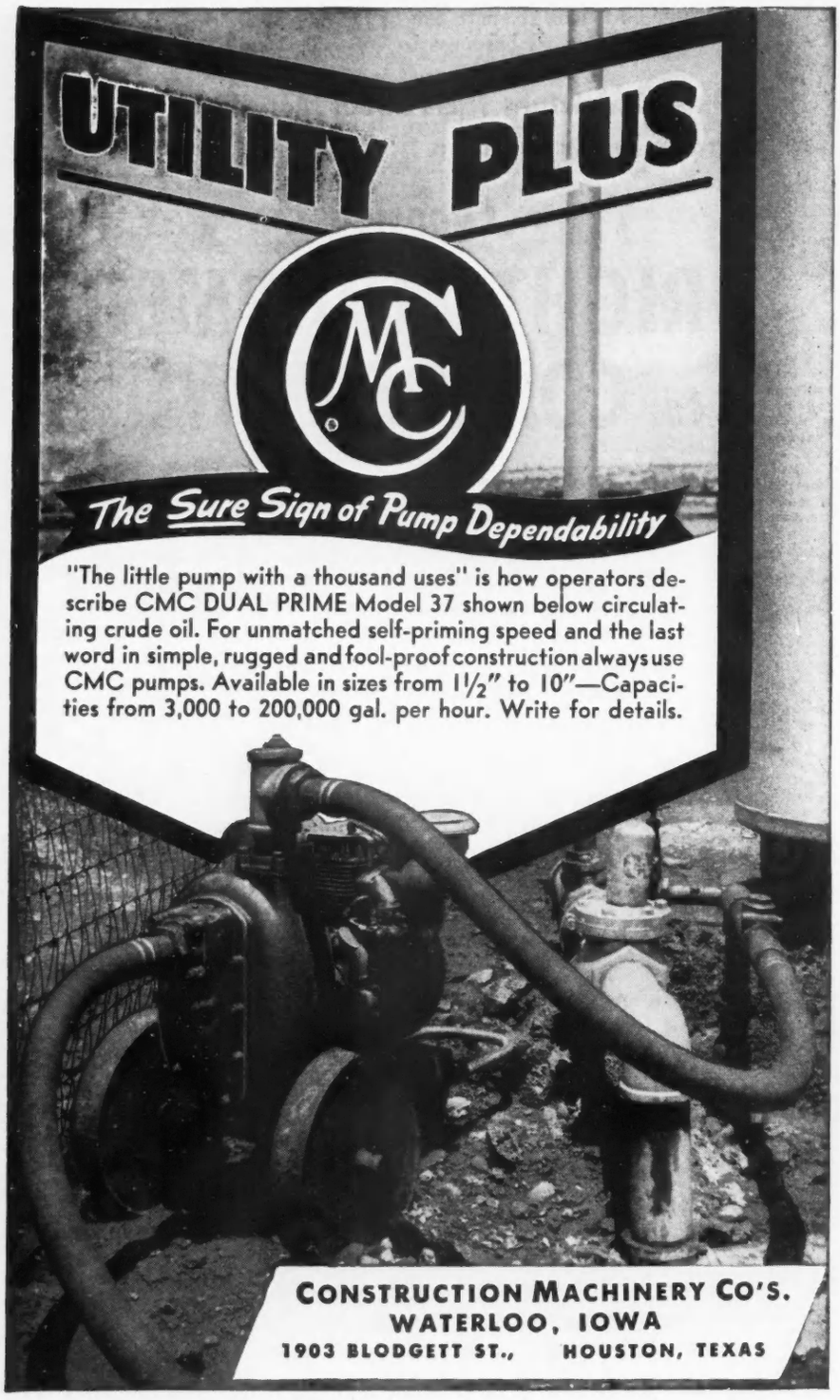
This item supplements American Sand-Banum Company, Inc., data on page 342 of Composite Catalog, 17th Edition.

A non-drying black paste, Tinallium Pro-Tex-It, is adaptable for all metals, woods and concrete mixes for preservation against weathering conditions, acids, fumes, chemicals, etc. It protects against alkali, rust, corrosion, oxidation, heat, cold, steam, gas or sulfur fumes, brine and other destructive agencies either above or below ground.

Tinallium does not stain water or other liquids and withstands contraction and expansion. It is fire-resistant and water repellent. It contains no lead oils, graphite, creosote or tar.

To apply the material, it is not necessary to clean, scour or flame-burn a rusty metal surface. It can be applied by brush while cold, as it has a temperature range of —75° F. to 500° F. The manufacturer claims high lubricating qualities for the coating.

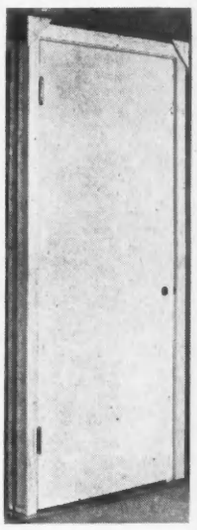
For additional information, write American Sand-Banum Company, Inc., 9 Rockefeller Plaza, New York 20.


UTILITY PLUS
CMC
The Sure Sign of Pump Dependability
"The little pump with a thousand uses" is how operators describe CMC DUAL PRIME Model 37 shown below circulating crude oil. For unmatched self-priming speed and the last word in simple, rugged and fool-proof construction always use CMC pumps. Available in sizes from 1½" to 10"—Capacities from 3,000 to 200,000 gal. per hour. Write for details.
CONSTRUCTION MACHINERY CO'S.
WATERLOO, IOWA
1903 BLODGETT ST., HOUSTON, TEXAS

Prefabricated Door

This item supplements Houston Ready-Cut House Company, Inc., data on pages 2285-2292 of Composite Catalog, 17th Edition.

Prefabricated doors in packaged units designed to fit any standard rough inside opening, are now available to speed oil field home construction.



The "Ready Hung Door" is a door-and-frame packaged unit, with the door hinged, lock installed, frame trimmed on both sides. The unit is ready for installation in any inside wall opening by semi-skilled field labor. Similar to the packaged window unit, the "Ready Hung Door" can be installed in 20 minutes, with only nail driving required.

The jamb, with trim or casing attached, is made in two parts which slip apart for installation from opposite sides of the wall opening. Jambs are adjustable for wall thicknesses from 4¼ to 5½ inches.

For additional information, write Houston Ready-Cut House Company, Inc., P. O. Box 124, Houston.

Insert Pump

This item supplements Harbison-Fischer Manufacturing Company data on pages 2178-2179 of Composite Catalog, 17th Edition.

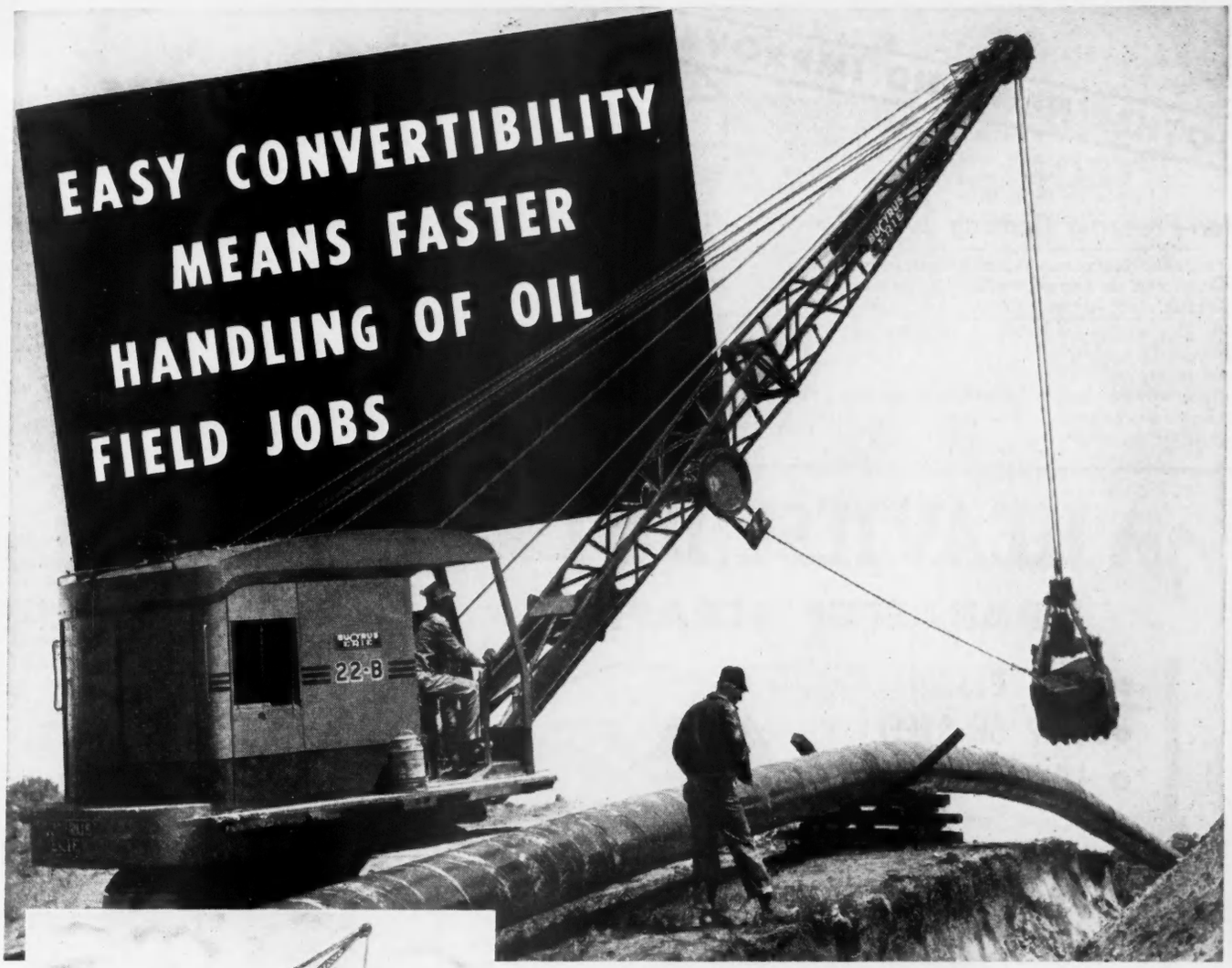
A new, all-purpose insert pump is designed to handle dirty, abrasive, or sandy production, and for wells having high subsurface formation temperatures.

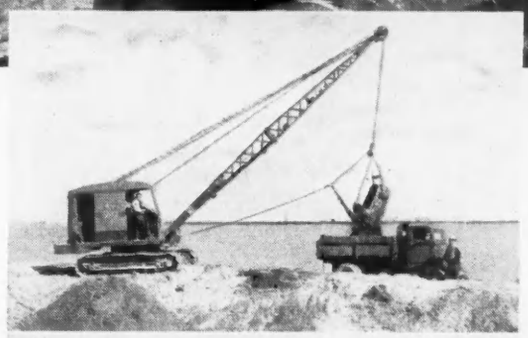
The pump has two concentric, reciprocating tubes which telescope over and in a third tube which serves as the pump barrel. The metal plunger is loose-fitting and free-falling in the barrel tube in order to provide ample clearance for sand and scale particles. The resulting fluid slippage is diverted to the small annular space formed by the outer tube and acts as an automatic fluid-seal and packing medium. Reversal of the pumping cycle occurs before any fluid is lost.

A no-go ring is located at the standing valve to prevent settling sand from forming around the hold-down and sanding in the pump. The pump has standard API ball and seat and cage for the plunger valve.

For additional information write Harbison-Fischer Manufacturing Company, P. O. Box 64, Fort Worth.

EASY CONVERTIBILITY MEANS FASTER HANDLING OF OIL FIELD JOBS





BUCYRUS-ERIE engineering brings you in-the-field convertibility at its most effective and simple level. You need do little more than switch booms to take full advantage of the front end that best fits your oil field job. Every versatile unit has the performance characteristics you need: fast-cycle shovels; accurate and stable cranes and clamshells; smooth-working long range draglines; dragshovels with powerful digging strokes. And outstanding dependability adds to the overall economy you'll experience with Bucyrus-Eries doing the work. See your Bucyrus-Erie excavator distributor for full details on Bucyrus-Erie gasoline, diesel and single motor electric ⅜ to 4 yard excavators.

BUCYRUS-ERIE COMPANY • South Milwaukee, Wisconsin

219E50

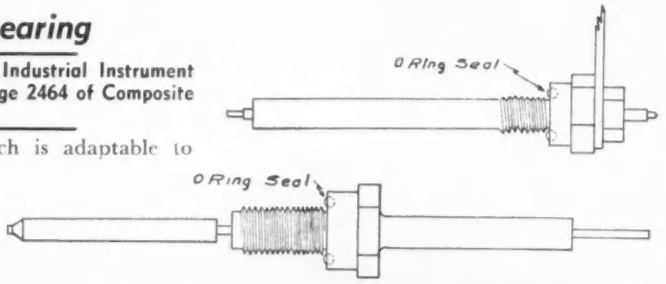
UNIVERSITY OF MICHIGAN LIBRARIES

OTHER NEW AND IMPROVED EQUIPMENT

Non-Freezing Bearing

This item supplements Industrial Instrument Corporation data on page 2464 of Composite Catalog, 17th Edition.

A new bearing which is adaptable to all types of mercury flow meters and controllers will not leak either in vacuum service or under extreme high pressures. The bearing is sealed so that the medium being measured does not contact the moving parts in the bearing housing. The seal system also eliminates the deficiencies of freezing and corrosion.



In installing the bearing, it is connected to the mercury float and the pen arm linkage. There is no stuffing box or seal. The bearing requires no lubrication.

Pictured are bearings for two types of meters.

For additional information, write Industrial Instrument Corporation, P. O. Box 1909, Odessa, Texas.

for HEAVIEST DUTY
PARAFFIN SCRAPING

- NEW DESIGN
- GRIP OF STEEL
- LONGER WEARING

More strength, wearability, and holding power here! The new M-25 S-I-W Paraffin Scraper hugs the rod with as much as 5000 pounds of GRIP! It stays put!

Field installation, with special S-I-W tools, is easy. The new M-25 has a super rugged design. Two heavy steel blades curl around the two shell halves to which they are welded. They exert continuous unplugging effect with every pumping stroke.

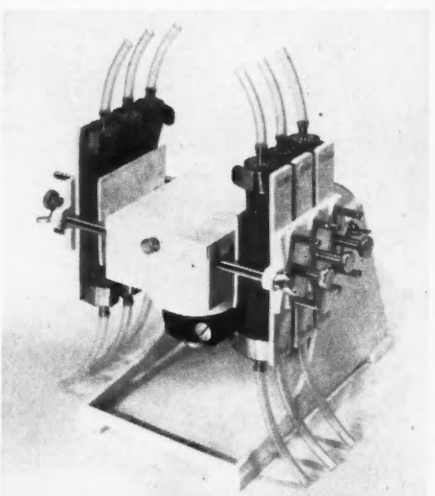
Check these big M-25 features: easy field installation . . . maximum effectiveness . . . reasonable cost. The new S-I-W M-25 scraper is a bear for wear . . . a profit-saving paraffin control tool!

Sunshine Iron Works

601 W. MURPHY - PHONE 4374 - ODESSA, TEXAS

Proportioning Pump

The Model O "6 in 1" pump is a unit combination of six separate pumps operated by a common motor of 1/20th horsepower, 110 volts, single phase. Each separate pump has a capacity of from 1 cc to 500cc's per minute when the solution is water or a free flowing liquid. A total capacity of 3000 cc's per minute can be obtained when all six pumps are hooked up to a common source of supply and a common outlet. A regulated flow of from



1 cc to 500 cc's per minute can be obtained from a single pump and a specific output of one and up to six separate liquids can be delivered similtaneously in desired proportion within the capacity of the unit.

For further information write Brosites Machine Company, 50 Church Street, New York 38.

Welding Process

Automatic hidden arc welding has been limited in application to jobs where the joint to be welded is in position for downhand welding. A new process, referred to as "3 o'clock" welding, removes this limitation and extends the advantages of automatic hidden arc welding to jobs where the joint is in positions other than that for downhand welding. Because joints can be positioned horizontally, welds from both sides of the joint can be made simultaneously.

For additional information, write The Lincoln Electric Company, 13010 Coit Road, Cleveland 1.

WORTHINGTON

"QD" SHEAVES

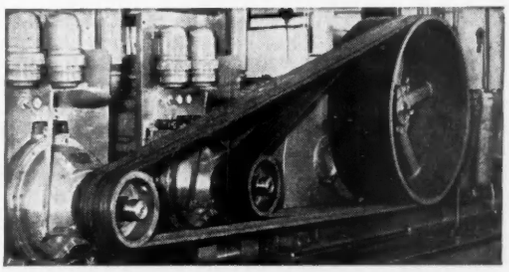
and

WORTHINGTON-GOODYEAR

V-BELTS

For Oil Field and Industrial Use

Complete Factory Stock in **HOUSTON, TEXAS**

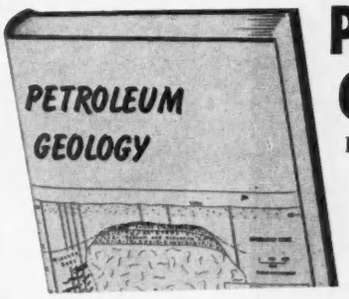


Additional Stocks Available Through Our Distributors

A. M. LOCKETT & COMPANY, LTD.

NEW ORLEANS HOUSTON DALLAS

Covers all 3 vital phases of . . .



PETROLEUM GEOLOGY

By KENNETH K. LANDES
University of Michigan

1. The geological occurrence of oil and gas deposits.
2. The geographical distribution of deposits.
3. Techniques for locating these deposits.

Practical! Comprehensive! Up-to-Date!

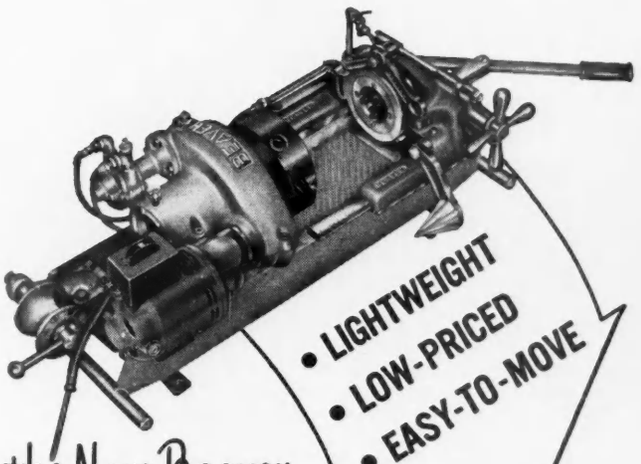
One of the best illustrated petroleum geology books available. The author emphasizes a practical approach to the subject—how gas and oil are trapped and how these traps may be discovered. Many books emphasize only stratigraphical details which are not directly applicable to oil discovery.

- 241 illustrations, 34 full-page (including 15 even larger), with a complete full-page legend for each.
- Up-to-date data. Includes newly discovered fields and other important information acquired up until July, 1950.
- Includes considerable important information on possible hydrocarbon sources of the future plus a "*Literature of Petroleum Geology*,"—a concise, authoritative list of *modern* references.

1951 660 Pages 241 Illustrations $10.00

Send today for 10-day free examination.
Please include name, address, and your firm's name.

JOHN WILEY & SONS, INC., Dept. WO-351
440 Fourth Avenue, New York 16, N. Y.



• LIGHTWEIGHT
• LOW-PRICED
• EASY-TO-MOVE

the New Beaver Model-E Pipe and Bolt Machine

The new low-priced, lightweight Beaver Model "E" is a "junior edition" of the heavy-duty Beaver Model A—which has, for the past 20 years, been the recognized leader in the field of portable pipe and bolt machines.

Although designed primarily for hardware stores and small piping contractors and industrialists, BIG contractors will find the new Model "E" useful on jobs requiring extreme portability.

A pipe machine is no better than the service back of it and our 50 years of experience in this field, and our reputation for high quality and friendly service, is your best guarantee of complete satisfaction.

WRITE FOR BULLETIN E

BEAVER PIPE TOOLS

254-300 DANA AVENUE • WARREN, OHIO, U. S. A.

NOW YOU CAN EASILY TAKE ACCURATE WIRE LINE MEASUREMENTS

THE CAVINS DEPTHOMETER

will tell you where bottom is in little more time than it takes to make a trip with your bailer Gives you accurate depth in plain figures—compensates for raising and lowering tools when feeling for bottom. Strong, light-weight, easily used, and priced right Send today for illustrated folder.

THE CAVINS CO.
2853 Cherry Ave., Long Beach 6, California

PARELEX
Electric Heaters
for
Oil Wells
Bottom Hole Tubing and Flowline Heaters for Paraffin and Heavy Crude
Write for Details
Model BH3
PARELEX CORPORATION
P. O. Box 552
HOUSTON 1, TEXAS

PRINTED FORMS FROM STOCK

☆

Immediate delivery of producing and pipe line forms made from our complete line . . . Write for completely illustrated catalog.

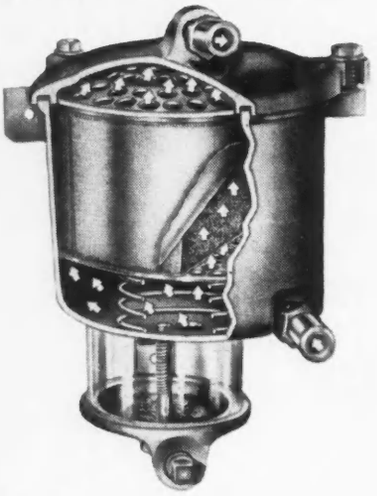
☆

GULF PUBLISHING CO.
P. O. Box 2608 Houston 1, Texas

IT'S NEW PELCO ..IT'S TOO!

OTHER NEW EQUIPMENT

Cooling System Filter



One of the major causes of overheating in liquid-cooled gasoline or diesel internal combustion engines is eliminated by a new electro-chemically activated cooling system filter. The filter, placed in the coolant line, softens and cleans the water or coolant and breaks up the accumulation of lime, rust, scale and sludge deposits in the radiator and cooling chambers of the motor block. Foreign matter is kept in suspension in the coolant, and, as it gradually goes through the process of filtering, the residue is deposited within the filter. Three models are available: Model "P" for capacities up to six gallons; Model "TB" for capacities from 6 to 15 gallons; and Model "TB Special" for capacities from 15 to 30 gallons.

For additional information, write Spark-O-Liner Corporation, Minneapolis, Minn.

Electronic Recorder

The new two-pen Speedomax electronic recorder records two functions simultaneously against time, both functions being drawn as continuous curves on a 9⅞-inch wide chart. Two electronically-amplified measuring circuits, two balancing motors, and two recording pens are all housed in one standard Speedomax case. Circuits can be furnished to work with themocouples, Thermohms, strain gauges, tachometers, thermal converters, pH cells, or most other types of primary elements. The instrument can operate controls or alarms. Recording pens operate overlapping or side-by-side, either across full scale or specified portion of the full width. Chart speed can be selected in the range of 1 to 1800 inches per hour. For identification, the instrument draws one curve in red ink, the other in black.

For additional information, write Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia 44.

Braided Packing

Palmetto 1330, Teflon impregnated packing, is prepared from chemically pure blue asbestos yarn, each strand of which is impregnated with Teflon by the same impregnating process employed in manufacture of all Palmetto Self-Lubricating Packings. Thus Palmetto 1330 is equipped with Teflon's full resistance to acids, alkalis, corrosive chemicals and solvents, from —150° F. to 550° F. The yarn is then braided, tightly to avoid leakage through the cross section and finished.

Because it may easily be cut or formed to any required packing size, Palmetto 1330 is adaptable as a storeroom item to meet all size packing requirements.

Palmetto 1330 is recommended for difficult services where conventional packings fail or are frequently replaced, particularly in the chemical field against corrosive fluids and solvents. Palmetto 1330 is supplied in braided form, in sizes from ⅛-inch square up and put up on 1 pound

spools, 5½-pound and 13-pound boxes, or on 25-, 50-, and 100-pound reels.

For additional information write Greene, Tweed & Company, North Wales, Penn.

in DALLAS
Best by Guest Test
LOMA ALTO HOTEL
4518 Lemmon Ave.
Wm. G. Marlin, Mgr.
LAWN HOTEL
3718 Lemmon Ave.
John W. McCann, Mgr.
LAKEWOOD HOTEL
1818 Abrams Rd.
Paul C. Bryant, Mgr.
and now—the new LYNN HOTEL
101 Air Conditioned Rooms . . 3405 Gaston Avenue . . Charles A. Clesson, Mgr.

OTHER NEW EQUIPMENT

Steel Tapes

A new line of precision case-type steel tapes is available in a number of sizes. No. 530 series has a ⅜-inch wide tape line etched with bright steel graduations on a no-glare black background. It is available in 25, 50, 75 and 100-foot lengths, with graduations in feet, inches and eighths. Cases consist of two plated steel sections covered by heavy artificial leather held in place by a nickel-plated concave-convex ring. The opening in the case is reinforced and equipped with a roller to reduce wear and prevent damage to the tape line and case.

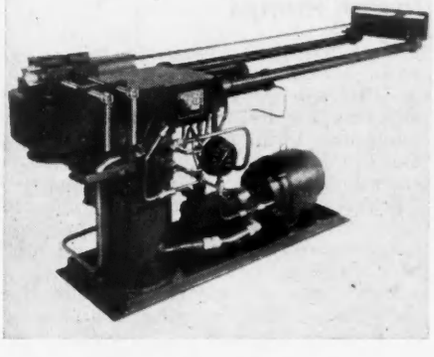
A folding tape hook mounted on the ring at the end of the tape permits accurate measurement from the end of the tape ring when it is hooked over an edge or projection. The tape has a winding handle which folds flush into the case and is released for use by a push button on the opposite side of the case.

For additional information, write The L. S. Starrett Company, Athol, Mass.

Pipe Bender

A new small bending machine, Model 800, is only 21 inches wide by 34 inches high by 78 inches long, but has power beyond its capacity of 1¼-inch O.D. x #16 BWG steel tubing. The unit is powered by a standard 2 horsepower, 220/440 volts, 3-phase, 60 cycle motor. It is operated by a single lever which when pushed down causes the bending arm to swing around to the degree of bend selected and stay there until the operator removes the bent part. Then the lever is moved up and the arm swings back to its original position. The bending die which is held on by spring clips, is a combination die with four different sizes. The bender can be changed from right-hand to left-hand operation by changing the pressure and clamping arms over and inserting the bolts into holes.

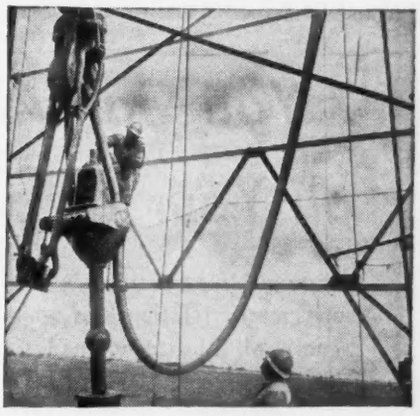
For additional information write Wallace Supplies Manufacturing Company, 1300 Diversey Parkway, Chicago 14.



3 WAYS TO CUT WELL DRILLING COSTS

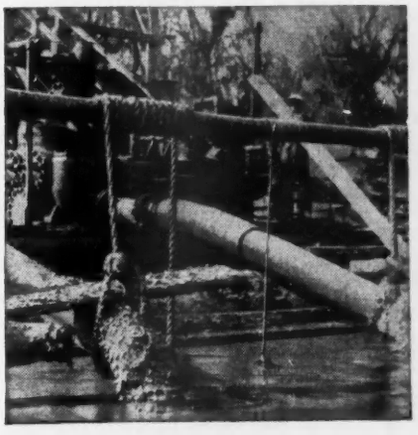
Throughout the oil industry, the name you see on hose is likely to be Hewitt-Robins. That's because for almost a century Hewitt-Robins has built into every oil industry hose the *specialized know-how* that pays off in *longer useful hose life* at lower cost. Below are typical examples of Hewitt-Robins specialization: three hoses that will increase drilling efficiency and cut operating costs at the derrick.

ROTARY DRILLING HOSE...



Hose that combines the strength of steel with the flexibility of rubber . . . made to order for today's higher pressures. Hewitt built-in, leak-proof couplings assure an unrestricted, synthetic-lined fluid-way *all the way*. Synthetic tube resists the wear of abrasive and corrosive drilling muds, and withstands the swelling and softening effects of oil. Carcass is high-tensile duck, heavily wire-reinforced for strength, safety, and flexibility. The tough cover resists cutting, abrasion and weather exposure. Specify *Monarch*® brand for deep-well work, *Ajax*® for medium-depth drilling, *Conservo*® for the short holes. Each is *right for the job!*

MUD PUMP SUCTION HOSE...



It's Hewitt-Robins *Monarch* brand and that means dependability *plus!* Dampens the pumping vibration that frequently loosens or breaks rigid connections between slush pump and mud pit; stops harmful "hammering" of pump pistons and valves. Smooth bore, wrapped duck, round-wire construction, with built-in nipples permanently sealed in the hose. Won't collapse or kink in the hardest service . . . and it stays on the job long after conventional mud suction hoses have failed.

ROTARY FLEXIBLE HOSE...

Used between the discharge end of the slush pump and the end of the standpipe line, Hewitt-Robins Rotary Flexible Hose dampens vibration efficiently and, unlike rigid pipe, it won't *crystallize*. Extremely flexible, easy to move or handle, tough and rugged, Rotary Flexible is another example of the *right hose* for the job.

★ ★ ★

QUICK DELIVERY

Get Hewitt-Robins drilling hose from your nearest Norvell-Wilder, Mid-Continent Supply, or our own warehouses in your vicinity.

HEWITT-ROBINS
Oil Industry Hose

HEWITT-ROBINS HR **INCORPORATED**

AIR HOSE • BARGE LOADING HOSE • FIRE HOSE • FLOATING ROOF TANK DRAINAGE HOSE
FLUE CLEANING HOSE • FUEL OIL & GASOLINE HOSE • OIL SUCTION & DISCHARGE HOSE
STEAM HOSE • TRUCK TRANSPORT & TANK CAR DISCHARGE-SUCTION HOSE • TANK TRUCK HOSE
WATER HOSE • PROPANE-BUTANE HOSE FOR HANDLING LIQUEFIED PETROLEUM GASES
CONVEYOR BELTING • PIPE SLINGS • RUBBERLOKT® WIRE WHEEL BRUSHES

Two-Cycle Diesel Engines

A new catalog describes the complete line of Series 71 two-cycle diesel engines. The book covers single and multiple engine units from 2 to 24 cylinders, with power ranging from 32 continuous to 780 intermittent horsepower. It contains data on GM diesel two-cycle design and interchangeability of parts; a "Select Your Power" chart covering 57 standard power take-off and seven torque converter models; engine illustrations and an outline of Detroit diesel service facilities.

For a copy of this catalog, write Detroit Diesel Engine Division, Advertising Department, 13402 West Outer Drive, Detroit 28.

Compression Fittings

A 12-page catalog illustrates the complete line of Dresser compression fittings for copper tubing and steel pipe. A two-page spread shows the 12 specific applications of Dresser fittings.

For a copy of this catalog, write Dresser Manufacturing Division, Dresser Industries, Inc., Bradford, Penn.

You Can Always Depend on Your BIG FOUR Friend

Friendship in business is not built over night. It is the outgrowth of satisfactory relationships which result in the mutual advantage and benefit of those concerned.

We at BIG FOUR appreciate the friendship of the oil industry as expressed in the confidence, co-operation and patronage we have enjoyed through the years.

The four fundamentals upon which BIG FOUR has built its business are:

1. ENGINEERED PRODUCTS
2. CONSISTENT QUALITY
3. FIELD PROVEN
4. PROMPT SERVICE

They're in every BIG FOUR product. Check 'em and see!

- Long Sweep Ells
- Goosenecks
- Release Valves
- Slim Hole Swivels
- Suction Strainers
- Long Drill Collars
- High Pressure Fittings
- Slim Hole Rotary Tables
- Traveling Blocks and Hooks
- Spears
- Sockets

BIG FOUR MACHINE AND SUPPLY COMPANY

Main Office: 1013-14 Hales Bldg., Oklahoma City, Okla.; Phone 79-1139

Shops and Plants

PAWHUSKA, OKLA. Box 477

CLAY CITY, ILL. Box 256

BEAVER TOOL & MACHINE CO., Maysville, Okla.
Manufacturer of Big Four Products

Complete Warehouse Stocks Available at:

C & W MACHINE WORKS COMPANY, Great Bend, Kansas
TILLERY AND PARKS, Odessa, Texas

EXPORT OFFICE: 233 Broadway, New York 7, New York

Diamond Equipment

Diamond bits and core barrels are catalogued in a new two-color, 20-page brochure, which also gives a brief historical background of the company and the diamond drilling industry. Parts and price lists for each type of core barrel are included, as well as schematic drawings.

For a copy of this brochure, write Drilling & Service, 3031 Elm Street, Dallas 1.

Safety Card

An illustrated, pocket-size card gives tips on proper care and use of slings for safe handling. The card was approved by safety directors and engineers at the National Safety Congress.

For a copy of card No. 50-38, write Macwhyte Company, Sling Department, Kenosha, Wis.

Induction Motors

Construction features of Allis-Chalmers large two-pole squirrel cage induction motors are given in a new bulletin. Cross-sections and photographs illustrate the text.

For a copy of Bulletin 05B7550, write Allis-Chalmers Manufacturing Company, 1063 South 70th Street, Milwaukee.

Casing Support

The new National Type "A" casing support, with slip load capacity ranging from 65,000 to 160,000 pounds, is described in a new three-color, four-page folder. The support is designed for wells where pressure is not present outside the suspended string.

For a copy of Bulletin 369, write The National Supply Company, Box 899A, Toledo, Ohio.

Motor Drives

Information on motor drives for all types of large air compressors is contained in the new issue of the E-M Synchronizer, No. 32. Authoritative application information and selection data on both motors and controls for a variety of compressor types and sizes are given in the two-color, 24-page bulletin.

For a copy of this bulletin, write Electric Machinery Manufacturing Company, Minneapolis 13, Minn.

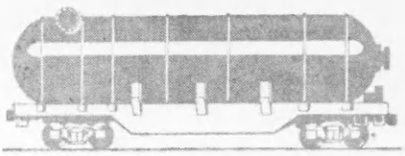
Insert Pumps

Two four-page, illustrated folders, describe operating and other technical data on three newly designed insert pumps. Discussed are the new "H-F 3-Tube" rod pump for lifting dirty, abrasive, sandy, and / or high-temperature fluids, and also recently introduced heavy-duty models of "Tuff-Temper" and "Precision" pumps for deep-well production. The literature contains engineering details, sizes, and other pertinent information.

For copies of these folders, write Harbison-Fisher Manufacturing Company, P. O. Box 64, Forth Worth, Texas.

. . . "to your order"

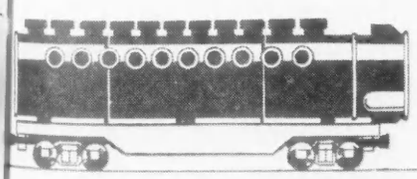
BS&B WELDMENTS



Close-by America's major producing and refining areas are the large, fully-equipped factories of Black, Sivalls & Bryson. For 58 years, BS&B has matched strides with the petroleum industry. Today's plants are capable of turning out special weldments of all shapes and sizes . . . in standard metals and alloys. Submerged arc automatic welding, modern sand-blasting equipment, X-ray controls, one of the largest gas-fired stress-relieving ovens in Mid-America . . . these and other facilities are at your command for special fabrication.

What's more, long-experienced BS&B engineers and research men are available for consultation and planning. And the work itself is done by BS&B craftsmen . . . men who daily surpass highest standards of code construction. Many of industry's advanced techniques were developed by BS&B workmen. Stainless steels, Hastelloy, high tensile carbon and nickel steels and clad materials are all part of everyday routine at BS&B!

Call your BS&B Sales Engineer today for information . . . or fill in the coupon below. All inquiries guarded in strict confidence.



Black, Sivalls & Bryson, Inc.

KANSAS CITY • TULSA • OKLAHOMA CITY

Cable Address: BLACKSIV, New York

BLACK, SIVALLS & BRYSON, INC., Section 1A-24-3

Sales Promotion Dept., 7502 E. 12th St. Kansas City 3, M

More information, please, about BS&B Weldments and spec fabrication. Send literature. ☐ Ask Sales Engineer to call.

Proposed tonnage_____

Length_____ Width_____

Material_____

NAME_____

TITLE_____

FIRM_____

STREET_____

CITY_____ STATE_____

L-O-N-G-E-R
THREAD LIFE

1. EXCLUSIVE 500-TON SPECIAL prevents washouts and galling. Makes breaking out easier; withstands highest pressures, and is unaffected by heat and moisture!
2. KANT-GALL TOOL JOINT COMPOUND
3. LONG-LIFE DRILL COLLAR COMPOUND

SOLD BY SUPPLY STORES EVERYWHERE

PETROLEUM DISTRIBUTING CO.
BOX 203—HOUSTON, TEXAS
Charter 5648

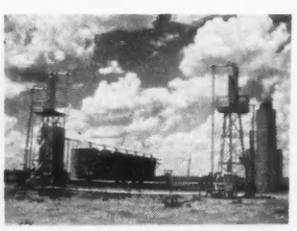
SECONDARY MODERN RECOVERY

TECHNICAL CONSULTING
PRODUCTION ENGINEERING
SERVICE, INCLUDING
CORE ANALYSIS

PRESSURE MAINTENANCE WITH GAS OR WATER

REPRESSURING WITH GAS OR WATER

Separators & Tanks with Individual Well Manifold to obtain Gas-Oil Ratio on Pressure Maintenance Operation.



WICHITA COUNTY, TEXAS

SURVEYS
ESTIMATES
DESIGN
INSTALLATION
SUPERVISION

PETROLEUM ENGINEERS
CABLE & STINE
WICHITA FALLS, TEXAS

Men in the Industry NEWS

P. D. Phillips, Jr.

F. O. Stivers

P. D. Phillips, Jr., has been appointed chief engineer for Humble Pipe Line Company to succeed the late **C. H. Lundt. F. O. Stivers** has been named assistant chief engineer.

Phillips was graduated from A. & M. College in 1934 with a B. S. degree in mechanical engineering. He began work with the company as a pipeliner at Longview during the same year. He later worked in the East Texas division engineering office, at McCamey, and at Midland in engineering capacities. After returning from army service in World War II, he transferred to Houston where he served as mechanical engineer, senior mechanical engineer, and supervising mechanical engineer. During the latter part of 1949, he was made assistant chief engineer.

Stivers received a B. S. degree in mechanical engineering from Purdue University in 1940. Before coming to work for Humble Pipe Line Company in April, 1945, Stivers was with the Southeastern Pipe Line Company and the Plantation Pipe Line Company. All of his service with Humble has been spent in the Houston office. Prior to his appointment as assistant chief engineer, he was senior mechanical engineer.

•

F. E. Melott, former area geologist and manager for Deep Rock Oil Corporation at Midland, Texas, has been transferred to be area geologist in the new office at Wichta Falls, Texas. **J. C. Meyer** has been named area geologist, and **H. W. Hitt**, new area landman at Midland.

Meyer, attended the University of Texas where he received his B.S. degree in 1941. Following four years with the U. S. Air Forces, he returned to the University as instructor in geology. He entered the commercial geology field in 1947 through a position with Barnsdall Oil Company at Midland. When Barnsdall merged with Sunray in 1950, he transferred to Service Drilling Company where he remained until the Deep Rock appointment.

Hitt attended Texas Christian University. He began work in 1941 with Shell Oil Company in Houston, then moved on for short tenures with the Ohio and Cities Service oil companies before joining the U. S. Air Forces in 1942. Following his release from service in 1947, he operated his own hardware company in New Mexico for a while, then worked for Seaboard Oil Company before joining Deep Rock. His experience includes scouting, leasing, claim and title work in the West Texas-New Mexico area.

•

George S. Koch has been appointed head of the Tax department of Standard Oil Company (N.J.) succeeding **Maxwell E. McDowell** who is retiring.

George S. Koch

Koch, has been with the company since February, 1935, when he was employed as a lawyer for the Tax department. He became assistant head of the department in June, 1945.

Prior to joining Jersey Standard, Koch was on the staff of the New York law firm, Cravath, Swaine & Moore. He was educated at the Universities of Kansas and Colorado and was graduated from the Harvard Law School, and is a member of the New York Bar. For many years he has been active in the Tax Section of the American Bar Association. He formerly lectured on tax matters at Columbia University.

McDowell has been with Jersey Standard since 1930 and has headed the Tax department since July, 1933. McDowell was graduated from Colgate and Columbia Universities and is a Trustee of Colgate.

For LONG TERM OIL LOANS
Repayable on Convenient Terms
Consult
PROPERTY CREDIT CORPORATION
OF DALLAS

PROPERTY CREDIT CORPORATION
PCC
OF DALLAS
MORTGAGES

Mercantile Securities Bldg. Dallas 1, Texas
Telephone: RANDOLPH 2419
Financing
Write for information about our new oil loan plan

THESE FAMOUS

Eastman

OIL WELL SURVEY INSTRUMENTS

FOR RENT

SINGLE SHOT SURVEY INSTRUMENTS

REGULAR TYPE—This instrument is favored because of its simplicity of operation. The Drilling crew can load, unload, and develop the recording discs in daylight. The discs are easy to read and simple to interpret. It is the most dependable survey instrument available.

SMALL TYPE—This instrument is used with retractable coring equipment, with non-magnetic drill collars, or special trigger bits. Its use results in substantial savings in rig time. The operation is identical to that of the regular type instrument.

THESE INSTRUMENTS ARE USED—

1. On all directional drilling operations for checking the course of the well.
2. To accurately record the course of the well as it is drilled in order to straighten the bore if necessary.
3. As a means of securing information to insure correct bottom hole spacing on the lease.
4. For determining the correct location of all points in the well in reference to the geological structure.
5. In orienting cores to correct for the true drift and deviation of the well bore.

DRIFT INDICATORS

TYPE "W" DRIFT INDICATORS—The Type "W" is a mechanical instrument which eliminates the use of batteries, lightbulbs, and photosensitive discs. The instrument incorporates a patented self-checking design which enables it to make two recordings. This feature insures that an incorrect reading will not be accepted.

TYPE "M" DRIFT INDICATOR—This instrument records photographically. Due to the length of the exposure necessary to make a recording, the operator is assured of a true reading. If the instrument's plumb bob is in motion, no record is obtained.

THESE INSTRUMENTS ARE USED—

1. To determine that the well is drilled within the drift limits specified in the contract.
2. As an assurance that there are no "doglegs" left in a straight well after it is drilled.
3. For economy. They are the most inexpensive straight-hole surveying instruments available.

In drilling a well on a flat structure to assure that the hole is moderately straight. After drilling is completed a Multiple Shot Survey is run to determine the exact course of the well.

CALL THE EASTMAN MAN NEAREST YOU!

(Consult Your Telephone Directory)

EASTMAN OFFERS YOU DEPENDABLE INSTRUMENTS, SERVICE AND RESULTS

These instruments are rented to operators and drilling contractors, complete with supplies and accessories. Frequent calls are made at the well by Eastman Service Men to insure satisfactory operation of the equipment.

SEE OUR CATALOG IN THE COMPOSITE CATALOG

EASTMAN OIL WELL SURVEY COMPANY

LONG BEACH DENVER HOUSTON

Transfers and Promotions:

R. W. Hofsess, operating engineer for Cities Service Gas Company, promoted to superintendent of production at Oklahoma City. **R. C. Jackson** transferred from Wichita to Oklahoma City as operating engineer and replaced by **R. B. Fleske,** who was promoted to superintendent of gas measurement. **Wayne Coffman** promoted to assistant superintendent of gas measurement; **Richard Sidwell** transferred from Hugoton to gas measurement department at Wichita, replacing Coffman as engineer. **Harold Hawley** transferred from the meter shop at Wichita to Hugoton as meter inspector. **John Inge** transferred from Wichita compressor station to compressor department at Wichita . . . **J. L. Ellis,** landman, Skelly Oil Company, has been transferred from Jackson, Miss., to Shreveport, as assistant to **E. M. Duffield,** district manager, succeeding **Ray M. Devero** who has moved to Oklahoma City . . . **Grant Molett,** scout for The California Company at Billings, Mont., has been transferred to the Land department at Casper, Wyo., with **Thomas Braden,** formerly of the Sales department, succeeding him in the scouting post . . . **Earl R. Downs,** district superintendent for The Ohio Oil Company, transferred from Henderson to Orange, Texas. **J. W. Gillespie,** transferred from Henderson to the general offices at Findlay, Ohio, as assistant to the general superintendent of production. **Lester Brown** promoted to district superintendent at Henderson. **J. S. Mathis** promoted to superintendent of drilling tools and transferred from Orange to Berwick, La. . . **Jimmie D. Harrington,** who has been a research technologist in Magnolia Petroleum Company's field research laboratories, Dallas, has been transferred to the Kermit Producing district and reclassified as petroleum engineer. **Gerald S. Young, Jr.,** formerly petroleum engineer at the Oklahoma division offices in Oklahoma City, has been transferred to the West Texas division offices with headquarters in Midland, Texas. **Thomas B. Lowary,** who has been petroleum engineer at the Duncan, Okla., producing district office, has been transferred to the Oklahoma division offices with headquarters at Oklahoma City.

E. E. Byrd was transferred from Gulf Coast division to Winters district, North Texas division, for work as assistant district superintendent for Humble Oil & Refining Company. **Riley A. Aucoin,** assistant division petroleum engineer, was transferred from East Texas division to Louisiana division as supervising petroleum engineer. **Philip E. Barber, Jr.,** division civil engineer, was transferred from Gulf Coast division to East Texas division as division civil engineer. **Harry D. Dickson,** senior supervising civil engineer, was transferred from Civil Engineering division in Houston to Gulf Coast division as division civil engineer. **W. J. Bielstein,** senior petroleum engineer, was transferred from the Petroleum Engineering division in Houston to Southwest Texas division as supervising petroleum engineer. **Jack M. Shepherd,** supervising petroleum engineer, East Texas division, was promoted to assistant division petroleum engineer. **J. G. Calvert,** district petroleum engineer of the London district, East Texas division, was transferred to the East Texas division office as a supervising petroleum engineer. **B. E. Crowder,** district petroleum engineer of the Talco district, East Texas division, was transferred to the London district as district petroleum engineer to replace Calvert, and **George C. Edgerton,** a petroleum engineer in the East Texas division office, was transferred to the Talco district as district petroleum engineer, replacing Crowder . . . **T. S. Richards,** production foreman at Palestine, Texas, South Texas division, Producing department, The Texas Company, transferred to Conroe, Texas, as field foreman in charge of Conroe and Palestine areas. **L. W. Goodrich,** production foreman of the Chocolate Bayou area, moved to Palestine. **J. F. Tindol,** petroleum engineer in the Central district, El Campo, transferred to Dayton, Texas, as production foreman.

Tom Borland, formerly assistant superintendent, Gulf Coast division for Stanolind Oil and Gas Company at Houston, has been transferred to the company's Central division in Oklahoma City in the same capacity.

In the American Tradition

PRESERVE YOUR FREEDOM!

Lexington – Concord – Yorktown – Germantown – Bunker Hill – Valley Forge – Fort Dearborn – Fort Sumter – Bull Run – Hampton Roads – New Orleans – Antietam – Fredricksburg – Gettysburg – Vicksburg – Chickamauga – Lookout Mountain – Missionary Ridge – Spotsylvania – Atlanta – Havana – Manila Bay – San Juan – Marne – Ypres – Salonica – Sedan – Cantigny – Belleau Wood – Chateau-Thierry – Mons – Amiens – Reims – Pearl Harbor – Guam – Wake Island – Surakarta – Cebu – Bataan – Corregidor – Java Sea – Rabaul – Coral Sea – Midway – Massacre Bay – Tobruk – El Alamein – Guadalcanal – Savo Island – Dieppe – Cape Esperance – Santa Cruz – Bougainville – Lae – Dakar – Morocco – Algeria – Naples – Sirte – Bizerte – Tunis – Arawe – Salerno – Messina – Burma – Tarawa – Makin – Kwajalein – Truk – Cassino – Anzio – Humboldt Bay – Cherbourg – Normandy – St. Lo – Bayeaux – Saipan – Ormoc – Philippine Sea – Siena – Port Apra – Rennes – Myitkyina – Chartres – Paris – Antibes – Avignon – Arras – Liege – Aachen – Le Havre – Rotgen – Peleliu – Brest – San Marino – Stolberg – Ryukyu Islands – Athens – Leyte – Subic Bay – Samar – Intramuros – Iwo Jima – Dueren – Bastogne – Metz – Rochefort – Luzon – Brachelen – Manila – Cavite – Cologne – Bonn – Mindanao – Bingen – Remagen – Panay Island – Okinawa – Sakishima – Kurile – East China Sea – Jola – Erfurt – Coburg – Essen – Elbe River – Weimar – Ie Island – Magdeburg – Parang – Leipzig – Halle – Munich – Milan – Turin – Kaesong – Seoul – Suwon – Chonan – Taejon – Kumchon – Chinju – Hamhung – Hungnam – Seriwon – Anju – Pyongyang – Inchon – Kimpo – Kapyong – Wonju – Chunchon – Chosin Reservoir – Sinuiju – Yalu River – Hyesanjin – Posong-ni – Wonsan – Kasan

"For those who here gave their lives that this nation might live" (let us dedicate ourselves to) "the unfinished work which they who fought here have thus far so nobly advanced . . . that from these honored dead, we take increased devotion to that cause for which they gave the last full measure of devotion."

Get Safer, More Efficient Drilling with SPANG

Prosser-Type Swivel

Rope Sockets

The HIGHER STANDARD

SPANG CABLE TOOLS

made by SPANG & CO. BUTLER, PA.

for

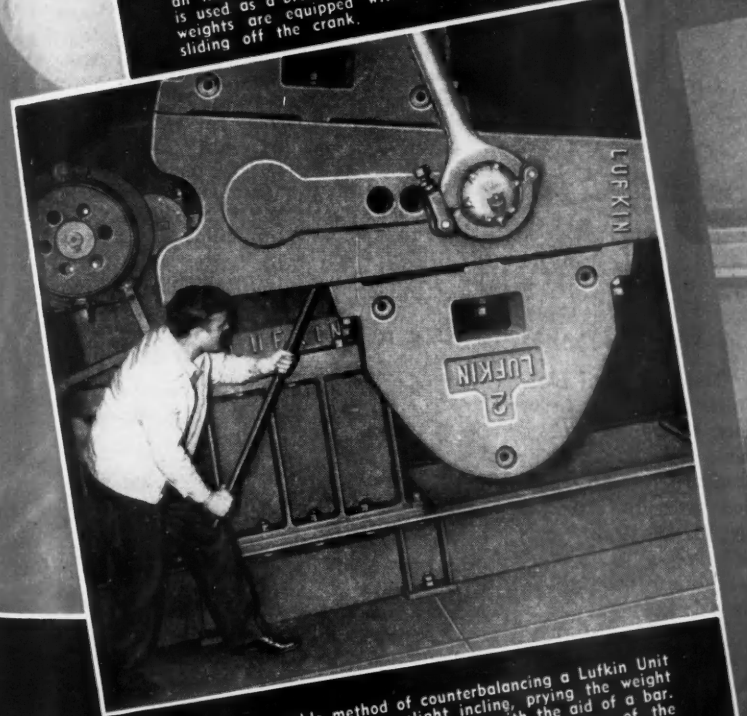
OIL WELLS • GAS WELLS • ARTESIAN WELLS
SHOT BLAST HOLES • PROSPECT DRILLING

SPECIFY SPANG—FOR SALE BY DEALERS EVERYWHERE

Lufkin PERFECTION

. . . . IN CRANK COUNTERBALANCING

"LET THE WEIGHTS DO THE WORK." Illustrated above is a very acceptable method of shifting weights on a Lufkin Pumping Unit. The crank is stopped on an incline, the three bolts are loosened and the lead bolt is used as a brake. This operation is quite safe because the weights are equipped with a steel safety lug to prevent sliding off the crank.



Another acceptable method of counterbalancing a Lufkin Unit is to stop the crank on a slight incline, prying the weight along the machined ways of the crank with the aid of a bar. This method is made easy by the notched bottom of the crank slot, enabling the operator to reach the desired position by an easy sliding motion.

The Lufkin Trout Crank gives perfect counterbalance adjustment from minimum to maximum effect with the greatest of ease. One man can easily do the job. Two methods are illustrated herewith. Any method of moving the weights is safe because the weights are equipped with steel safety lugs to prevent sliding off the crank.

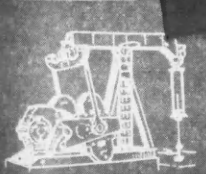
Operators find the Lufkin Trout Crank superior for oil field pumping units because of these outstanding features:

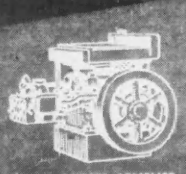
1. **EASE OF ADJUSTMENT**—one man can counterbalance a well.
2. **SAFETY**—a steel safety lug prevents the weights sliding off the crank.
3. **PRECISION** — counterbalance of minimum to maximum effect can be obtained by moving weights in a straight line.
4. **SIMPLICITY**—only three bolts to loosen.

LUFKIN FOUNDRY & MACHINE COMPANY
LUFKIN, TEXAS

Branch sales and service Houston, Dallas, New York, Tulsa, Los Angeles, Seminole, Oklahoma City, Corpus Christi, Odessa, Kilgore, Wichita Falls, Casper, Wyoming; Great Bend, Kansas.

Lufkin Equipment in CANADA is handled by
THE LUFKIN MACHINE CO., LTD. 14321 108th Avenue, Edmonton, Alberta, Canada


LUFKIN PUMPING UNITS


LUFKIN-COOPER-BESSEMER ENGINES

LUFKIN OIL FIELD AND INDUSTRIAL TRUCK TRAILERS

INDUSTRIAL SPEED REDUCERS AND INCREASERS

DIVISION LUFKIN FOUNDRY & MACHINE COMPANY INDUSTRIAL, MILL AND AUTOMOTIVE SUPPLIES

J. M. Wilson has been promoted from assistant district superintendent to district superintendent, Central district, El Campo, Texas, South Texas division, Producing department, The Texas Company.

Wilson succeeds **W. F. Batson,** who is retiring. **E. A. Staples,** field foreman, will advance to assistant district superintendent to replace Wilson.

Wilson was graduated from Texas A. and M. College in 1935 with the B.S. degree in petroleum engineering. He started to work for The Texas Company as a roustabout at Hull, Texas in 1935. In 1940 he was made petroleum engineer. After serving in the army during World War II and leaving the service with the rank of captain, he returned to the company and was named field foreman in March, 1947. A month later he became assistant district superintendent.

Staples received the B.S. degree at Texas A. and M. College in petroleum engineering in 1938, when he also was employed by the company as a rotary rig helper. He was a junior petroleum engineer in 1940, when he went into the air corps. He came out of uniform as a captain in 1947. After several promotions he became field foreman and has served in that capacity to the present time.

•

E. F. Battson, W. C. MacMillan, and **J. W. Liddell** have been named to new executive positions in Continental Oil Company. Battson, formerly vice president and regional general manager, Rocky Mountain region, Denver, has been named administrative vice president, Houston. MacMillan, former executive vice president, is now senior vice president, Houston, and Liddell was advanced from regional general manager, Eastern region, New York City, to vice president and regional general manager, Rocky Mountain region, Denver.

E. F. Battson

W. C. MacMillan

J. W. Liddell

With Continental for nearly 30 years, Battson has been a vice president since 1948, and vice president and regional general manager at Denver since 1949.

MacMillan has been with Continental more than 22 years, having joined the company as an instrumentman in the Geological department at Shawnee, Okla. Through various promotions in exploration and production, he was elected vice president in charge of production in 1943; vice president and administrative assistant to the president in January, 1949, and executive vice president in September, 1949.

Liddell, a graduate of Texas A. and M. College, has been with Continental more than 25 years.

•

George W. Chapman has been appointed manager of the Land department of Sun Oil Company's Southwest division at Dallas. He succeeds **Sam M. Gladney,** who has given up his Land department duties to devote full time to his post as assistant manager of the division.

Chapman studied at the University of Michigan and began his career in petroleum with an Oklahoma drilling contractor. He joined Sun 21 years ago in Tulsa and transferred to Dallas in 1931. He became assistant manager of the Land department in 1944.

•

Don Bills has been appointed acting district geologist in the Illinois Basin area for Cities Service Oil Company (Del.), replacing **Ralph Hamblin** resigned. The Cities Service district geological and land offices for the area are in the Schultz Building in Olney, Ill.

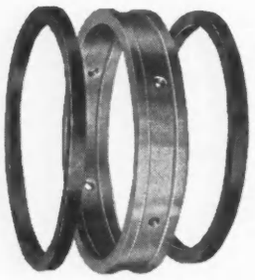
RED DEVIL

"DIA-HARD" LINERS

For high pressure abrasive service

Forged in one piece from highest quality alloy steel. The deep HIGH-CARBON wear resistant case of maximum hardness and uniformity is obtainable only by our SPECIAL "DIA-HARD" PROCESS, greatly excelling all other known methods for longer life liners. The bore is PRECISION HONED, and ACCURATE OUTSIDE DIMENSIONS insure a perfect working fit with liner packing assembly and pump cylinder for positive leakproof sealing. Write for Catalog No. P-120.

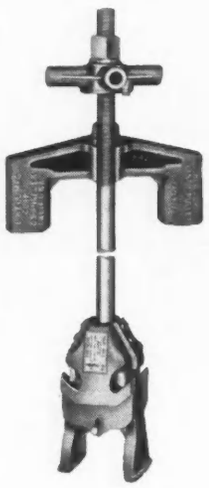
TELL-TALE LINER PACKING ASSEMBLIES



Gives warning before damage

Tell-Tale Liner Packing Assembly consists of two "DIA-TEX" oil and heat resistant sealing rings separated by a precision made steel, corrosion-resistant lantern ring. Internal leakage is detected instantly in slush pumps through "tell-tale holes" before costly fluid cuts occur to cylinder walls. There is either a Tell-Tale Liner Packing Assembly or a "DIA-TEX" Sealing Ring available for all makes of slush pumps. Write for Catalog No. P-121.

LINER PULLERS



Save valuable time and labor

The Red Devil Liner Puller is a strong, heavy duty, dependable tool capable of pulling the most obstinate liner. Its operation is simple. There are no pins, connecting links or other small parts to bend, shear, break or become lost.

The "Universal Type" Puller (as illustrated) is designed for slush pumps. The "Expanding Grip Type" is designed for pulling thin wall-driven tube type liners, as used in small pumps. Write for Catalog No. P-122.

See Composite Catalog . . . For more detailed information on Red Devil Products, see the Composite Catalog or write for special price catalogs noted above. Red Devil products are available through your supply store.

OIL WELL MANUFACTURING CORP.

6008 S. Alameda St., Los Angeles 1, Calif.

MEN IN THE INDUSTRY NEWS

Ralph O. Rhoades has been appointed to the newly created position of executive assistant to the vice president on the staff of the Production department in Pittsburgh, for Gulf Oil Corporation.

Rhoades received a B.A. degree in geology from Stanford University in July, 1922, and joined Gulf in 1926 as a geologist in South America. Subsequently he served the company in the Middle and Far East and in Europe. In 1939 he was assigned to Gulf's London office.

Rhoades was tranferred to Pittsburgh in 1940 and rose from geoglogist to staff geologist and chief, Land and Exploration branch, before his newest appointment.

Effective with Rhoades' appointment, the title of staff geologist has been discontinued and **B. F. Hake** has been appointed chief of the Land and Exploration department.

Hake received his B.A. degree in geology from Stanford University in 1920, and a masters degree in geology from the same University in 1930. He joined Gulf in 1934, doing field and subsurface geology and petroleum eningeering in Michigan, and subsequently was in charge of the Company's geological operations in Eastern U.S.

Hake entered the Army Corps of Engineers in October, 1942, as a staff geologist with the rank of Major, and in August, 1943, was transferred to Washington to do military planning related to petroleum. He was further assigned to the Quartermaster Corps as a lieutenant colonel and served as chief, Development and Rehabilitation section, and chief, Planning branch, Fuels and Lubricants division, Office of the Quartermaster General, U. S. Army. He rejoined Gulf in October, 1945 as assistant to the vice president, Gulf Oil Corporation, New York City, and four years later was transferred to the general offices in Pittsburgh as engineering geologist.

•

John Shaw has been elected an assistant treasurer of Gulf Oil Corporation, and will be responsible for cash disbursements from the headquarters office, general banking, and other matters of a domestic financial nature.

John Shaw

Shaw joined Gulf in 1930 and has been in the Treasury department since that time. His office will continue to be in the Gulf Building, Pittsburgh.

•

Dr. A. Ten Dam, formerly senior paleontologist for Societe Nationale de Recherche et d'Exploitation des Petroles en Algerie (S.N. REPAL) at Relizane, Algeria, has joined the staff of Maden Tetkik ve Arama Enstitusu at Ankara, Turkey.

•

James W. Baldwin, Bartlesville, Okla., has been named manager of the Federal Income and Excise Tax department of Cities Service Oil Company (Del.).

When a girl becomes very expert at dancing a waltz

People may get the impression that she can't Rhumba or Samba --and that's false.

It's the same with us and the Oil business, a strict labor of love.

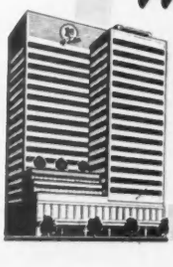
But-----Heavens Above!

We make loans, handle paper and do business in such diversified fields as ranching, groceries, retailing, automotive, farming, building, and so on ad infinitum. . . .

Thus, when anyone says ALL we bank on is the Oil Business, why---- we fight 'em. . . .

So -- when for any kind of banking in and around Tulsa, you get a thirst. . . .

Why--then--think, FIRST.



THINK 1st of Tulsa

★ In our Correspondent Bank Department, You should know, Elmo Thompson, Joe Byrd, Harry Lane, Bill McLean, and Dick Wagner.

THE FIRST NATIONAL BANK AND TRUST COMPANY OF TULSA

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Norman D. FitzGerald, Abilene, Texas, has organized the Saxon Drilling Company in partnership with **D. D. (Flossie) St. John,** fomerly of Olney and Ballinger. FitzGerald will supervise field operations. The new company has a rotary rig adapted for drilling wells from 2000 to 4000 feet deep in West Central Texas.

•

Frank Lindeman, Jr., fomerly operating superintendent, and **H. T. Hunter,** formerly assistant division production superintendent in the Central division, Stanolind Oil and Gas Company, have been promoted to general superintendent of the Producing department and operating superintendent in charge of production and drilling, respectively.

•

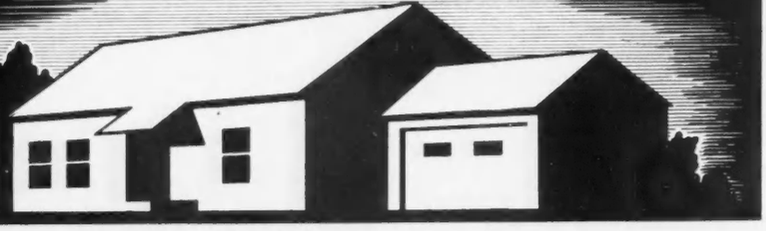
O. E. McClatchey, Tulsa, for many years purchasing agent for Barnsdall Oil Company until its merger with Sunray Oil Corporation, has been called to Washington, D. C., as an assistant in the Petroleum Administration for Defense, serving in the division for the allocation of material for oil and pipe line transportation.

FIELD HOUSING
as Easy to Buy as Equipment

It is just as easy to order the field housing you need as it is to order valves, rock bits or sucker rods. Choose the types of STURDYBILT houses you need from the many designs available, tell us where they are to be erected . . . and that's all there is to it.

WRITE FOR INFORMATION

MANUFACTURERS OF SPECIAL MILLWORK
DISTRIBUTORS OF
JOHNS-MANVILLE BUILDING MATERIALS
CURTIS WOODWORK



STURDYBILT
SOUTHERN MILL & MANUFACTURING CO.
Tulsa, Oklahoma
Prefabricated, Demountable Houses

PREFABRICATED HOME MANUFACTURERS INSTITUTE phmi
STURDYBILT HOUSES COMPLY WITH COMMERCIAL STANDARD CS125-45 OF THE NATIONAL BUREAU OF STANDARDS FOR PREFABRICATED HOMES

Rayburn L. Foster has been elected a director and member of the executive committee of Phillips Petroleum Company. He succeeds **F. E. Rice,** who retired after almost 33 years service with the company.

Rayburn L. Foster

Foster, who has been with Phillips for more than 22 years, became vice president and general counsel of the company January 1. He had previously been assistant general counsel.

•

John Kelly, assistant manager of Continental Oil Company's motor transportation division, Ponca City, Okla., has been promoted to administrative assistant to **W. L. Kygar,** president of Continental Pipe Line Company.

Elmo P. Hester, Houston, regional contract superintendent in the southern region of Continental Oil Company's motor transportation division, has been promoted to succeed Kelly as assistant manager of the division.

Kelly will continue to make his headquarters in Ponca City, where offices of Continental Pipe Line Company are located. Hester will move from Houston to Ponca City in his new assignment.

•

D. W. Cameron has been appointed manager of the Crude Oil Purchasing department of The Carter Oil Company. He succeeds **H. F. Miller,** retired. Cameron formerly was assistant to Miller.

D. W. Cameron

Cameron began work with Carter in 1935 as a hall boy after graduating from the University of California at Los Angeles. He soon was transferred to the Scouting department and became chief scout in October, 1946. He served in the U. S. Navy for 26 months during World War II. Subsequent to his appointment as chief scout he became assistant to the president and in 1949 became assistant to Miller.

C. M. York, formerly chief clerk of the department, will be assistant to Cameron.

W. E. Emery will continue in his present position as assistant manager of the department.

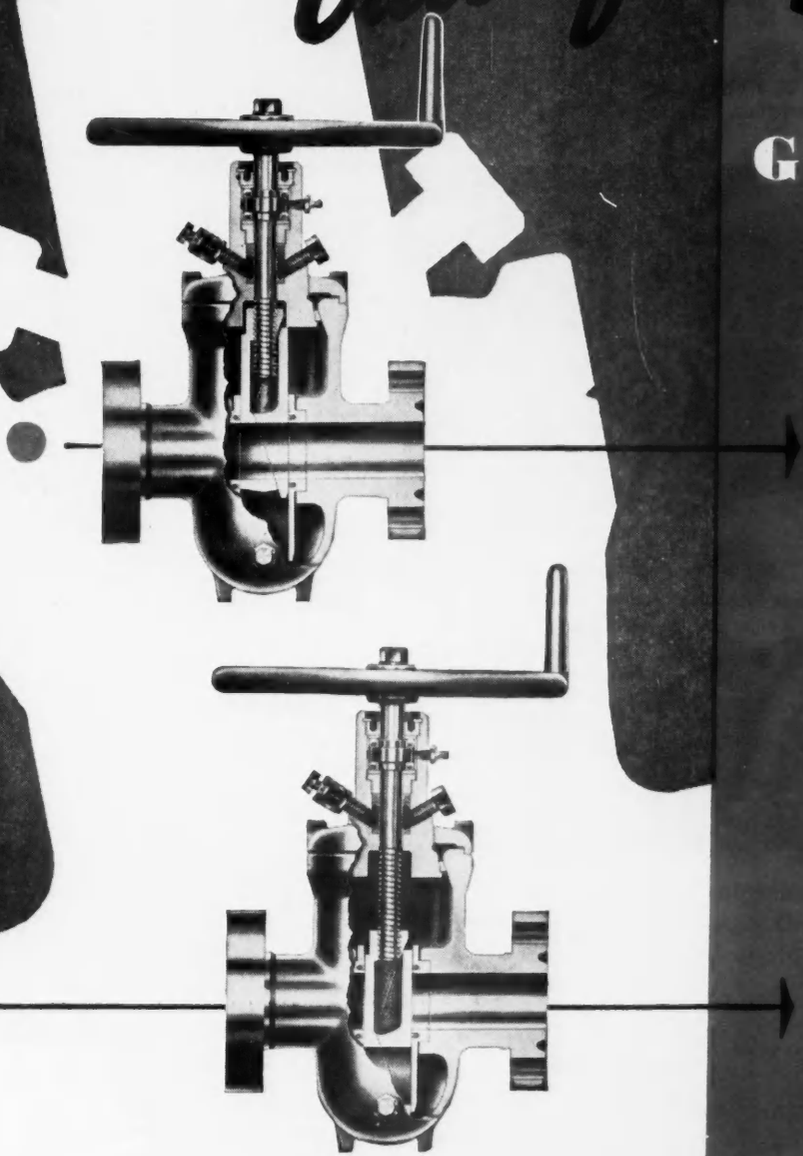
•

Alan J. Lowrey, San Francisco, and **K. E. Kingman,** Los Angeles, have been elected vice presidents of Union Oil Company of California.

Lowrey has been assistant to the president since joining Union in 1939. A Harvard graduate, Lowrey served as a Navy flier in both World Wars. Until he joined Union, he was active in banking circles in Hawaii, San Francisco and New York.

Kingman, a graduate of California Institute of Technilogy, joined Union in 1929.

An Open and Shut Case of Superiority!



W-K-M GATE VALVES

In the long run W-K-M Valves have proved their case for superiority in the oil industry. Over 80% of all the World's high pressure wells are equipped with W-K-M Valves.

OPEN

Smooth, full-bore opening entirely through the valve. No cavities or corners to collect sediment or cause turbulence. Seats not exposed to cutting or abrasion.

Free Floating operation against full-rated pressure is obtained by the W-K-M Parallel Expanding Gate. A slight movement of the wheel collapses the gate away from the seats, eliminating wedging and freezing. Double roller thrust bearings on the stem make operation even smoother.

The Expanding Gate gives a perfect seal against both seats when valve is open as well as closed.

CLOSED

Pressure Seal Bonnet requires no flanges, studs or nuts. Greater pressure gives tighter seal. Self-adjusting to temperature changes.

W-K-M Valves hold tight against pressure in both directions. The Gate expands against both seats with a slight turn of the handwheel and seals perfectly.

W-K-M SUPERIOR DESIGN INCLUDES THESE ADDITIONAL FEATURES

- **Combination wipe and seal rings keep the gate clean . . . pressure out . . . grease in.**
- **Combination plastic-chevron packing—uses no gland or gland follower.**
- **Lubricant contained in entire body . . . no special lubricant required . . . seal does not depend on lubricant.**
- **Oversize bronze renewable seats.**

W-K-M Company

OIL FIELD, PIPE LINE & INDUSTRIAL EQUIPMENT

HOUSTON, TEXAS, U. S. A.

LOS ANGELES

Cable Address: "WILKOMAC"

Export Office: 30 Rockefeller Plaza, New York, N. Y.

George Legh-Jones, chairman of the board of Shell Caribbean Petroleum Company and Shell Oil Company, and managing director of the Royal Dutch Shell Group of Companies has been knighted. Announcement of the honor was made in the King of England's official birthday list.

•

J. B. Jarman, Service Pipe Line Company, has been promoted from cost engineer to superintendent of materials in the Operating department, Tulsa. He is succeeded by **C. V. Rohleder,** promoted from junior engineer.

John Ware has resigned as district manager for Barnsdall Oil Company, Oklahoma City, and has set up a geological department for the Harper-Turner Oil Company.

•

H. D. Teel has been promoted from geologist in the North Central Texas district for Stanolind Oil and Gas Company to assistant to the division geologist in the North Texas-New Mexico division.

•

D. E. Pyburn, Shreveport, La., and **J. W. Newman,** Kilgore, Texas, have formed the P. & N. Drilling Co., headquartered at Shreveport. Both resigned from Retsal Drilling Company.

•

John L. Cloud, formerly auditor of Houston Oil Company of Texas, has been promoted to director of employe relations. Except for a period of 2½ years when he was in the Marine Corps, he has been with the company since January, 1939.

John L. Cloud

Claude C. Harris

Claude C. Harris has joined the company as controller. He was formerly controller of Fish Constructors, Inc.

•

George L. Ellis, senior geologist, Stanolind Oil and Gas Company, has been named division geophysical coordinator for the Permian Basin with headquarters at Fort Worth.

•

H. Wayne Hoylman has resigned as chief geophysicist of Fairchild Aerial Surveys, Inc., Los Angeles, and has established an office as consulting geophysicist at 815 Architects Building, Los Angeles 17.

•

C. Philip Collins has resigned from Eastman Oil Well Survey Company after 16 years of service. He will enter the drilling and production field with headquarters in Denver.

•

J. R. Williams, formerly with Walter Davis, independent of Casper, Wyo., is now associated with G. W. Anderson Oil Leasing Service, Salt Lake City, Utah.

•

Greer Streetman, formerly with Baroid Sales Division in Oklahoma, is scouting for Amerada Petroleum Corporation in Casper, Wyo., succeeding **Howard Jennings,** called to military duty.

•

A. M. Culver and **John Harrison,** landman and geologist, respectively, for Argo Oil Corporation, Casper, Wyo., have resigned to become private consultants in their respective fields.

•

Prentice F. Brown, formerly in immediate charge of Honolulu Oil Corporation's operations in Texas, has resigned as vice president and director of the company. He had been with Honolulu for 23 years.

•

Ernest M. Black has resigned as research director of the Oklahoma Tax Commission and has joined Kerr-McGee Oil Industries, Inc., Oklahoma City.

FIRST IN CANADA'S OIL FIELDS

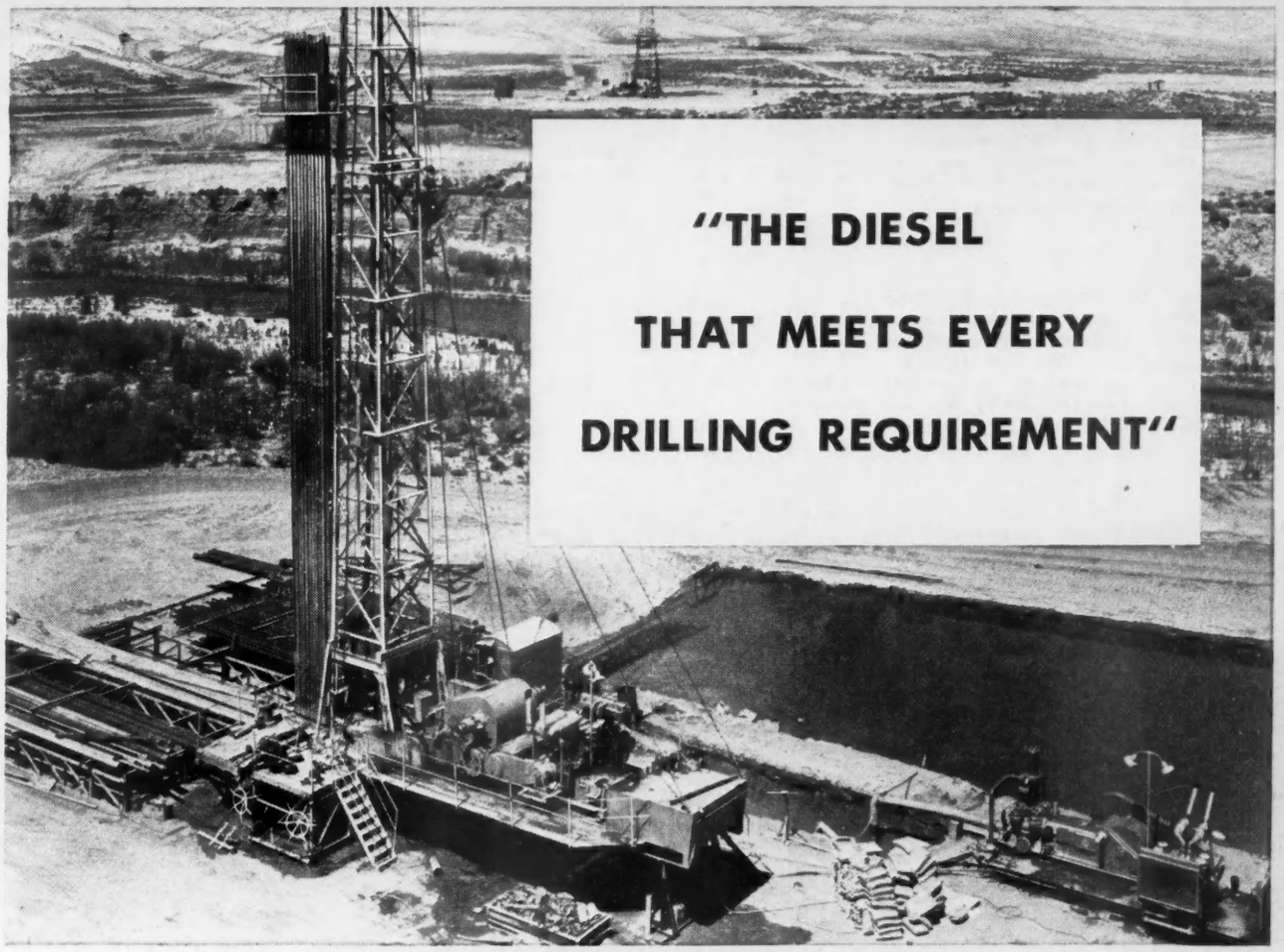
Branches throughout Canada's oil-rich western plains. On-the-spot information available through J. C. Mayne, Supervisor, Calgary, Alberta, or Head Office, Montreal

We do not provide information on oil securities

Assets exceed $2,497,000,000

THE ROYAL BANK OF CANADA

Over 750 branches in Canada and abroad



Three GM Series 71 Diesel Twin Sixes, with integral torque converters, drive Ideco drawworks and mud pumps.

OIL well drilling contractor M. H. Stansbury, of Bakersfield, California (who has been drilling in California fields since 1935), writes as follows:

> "The GM Diesel engine is of the right size, sufficient horsepower and all-around characteristics to meet the severe requirements of oil well drilling. Also the immediate availability of repair parts and service is highly important to this business."

Two-cycle operation, with power at every piston downstroke, gives GM Diesel engines more power in fewer units that weigh less and take up less space. GM's exclusive system of direct fuel injection—with easily replaceable unit injectors—insures cleaner, more accurately controlled combustion and eliminates troublesome high-pressure fuel lines. The same basic design is used in all Series 71 engines from 2-cylinder single to 24-cylinder multiple units. This assures high parts interchangeability and low-cost maintenance. And these engines are backed by General Motors' world-wide service facilities.

Before you buy new equipment or repower old, it will pay you to get all the facts about GM Series 71 and 6-110 Diesel engines and the new GM Diesel Torque Converter units. *Write, wire or phone for details.*

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES...*Up to 275 H.P.* **DETROIT 28, MICHIGAN** MULTIPLE UNITS...*Up to 800 H.P.*

GENERAL MOTORS

DIESEL BRAWN WITHOUT THE BULK

GM GENERAL MOTORS DIESEL POWER

GENERAL MOTORS CORP., DIESEL ENGINE SALES, PETROLEUM INDUSTRY, 1504 Philtower Bldg., TULSA 3, OKLAHOMA

CALIFORNIA: Anderson-O'Brien Co., LOS ANGELES 21; Lawless Brothers, BAKERSFIELD; West Coast Engine & Equipt. Co., BERKELEY. **ILLINOIS:** Western Machinery & Engine Co., CENTRALIA. **KANSAS:** Diesel Equipment Co., Inc., WICHITA. **COLORADO:** Colorado Builders' Supply Co. (Equipt. Division), DENVER. **LOUISIANA:** George Engine Co., Inc., HARVEY; United Tool Company, SHREVEPORT. **MISSISSIPPI:** Taylor Machine Works, JACKSON. **MISSOURI:** Western Machinery & Engine Co., ST. LOUIS 10. **MONTANA:** Seitz Machinery Co., Inc., BILLINGS; Mountain Tractor Co., MISSOULA. **OKLAHOMA:** Diesel Power Co., OKLAHOMA CITY. **TEXAS:** Stewart & Stevenson Services, Inc., HOUSTON 1, McALLEN, DALLAS, CORPUS CHRISTI, WICHITA FALLS; Haynes Machinery Co., PLAINVIEW; Empire Machinery Co., Ltd., ODESSA. **WYOMING:** Colorado Builders' Supply Co. (Equipt. Division), CASPER.

DEATHS

Lee C. Bock, 58, general purchasing agent of Gulf Oil Corporation, died February 3 at his home near Pittsburgh. Bock, who had been with Gulf 42 years, was made general purchasing agent for the Gulf companies in 1946. In 1949, when the position of director of purchases was discontinued, he became head of the Purchasing department under his previous title.

•

Walter Geist, 56, president Allis-Chalmers Manufacturing Company, Milwaukee, died January 29. Geist left school in 1909 to join Allis-Chalmers, but continued his education by taking evening and extension courses at the University of Wisconsin. After holding several posts of increasing responsibility, he was named assistant manager of the Milling department in 1928. It was while he was an engineer in charge of transmission in the Milling department that he developed the multiple V-belt Texrope drive, and promoted its sales. In 1933 he was named general sales representative for the General Machinery division, in 1939 was elected a vice president, and in 1942, president.

•

Thomas E. Haney, 76, veteran oil well supply salesman who has been for 30 years with Jones and Laughlin Supply Company, died January 16 in Tulsa.

Ralph C. Van Matre, 51, vice president and general manager of the Mid-Continent division of Pacific Pumps, Inc., died January 11 in Whichita Falls, Texas, while on a business trip. His home was in Tulsa. Van Matre had been with Pacific Pump 18 years, and had lived in Oklahoma City, Houston and Dallas while he was sales manager of the Mid-Continent division.

R. C. Van Matre

•

Tom W. Fentem, 51, secretary-treasurer for Kerr-McGee Oil Industries, Inc., Oklahoma City, died February 9. He had been a business associate of Senator Robert S. Kerr of Oklahoma for about 20 years.

•

C. F. Gibson, 58, former drilling superintendent for Sinclair Oil & Gas Company, died February 11 in Fort Worth. After leaving Sinclair he was an independent contractor and producer. He recently has been in the Construction division of Brown & Root, Inc.

•

Frank B. Bowling, 63, an employe of Mid-Continent Petroleum Corporation for 22 years before he resigned in 1947, died January 25 in Guthrie, Okla., while on a business trip.

•

Harvey C. Davis, 65, retired assistant superintendent of production for Gulf Oil Corporation, Tulsa, died January 29. He had joined the company in 1917 when he first went to Oklahoma.

•

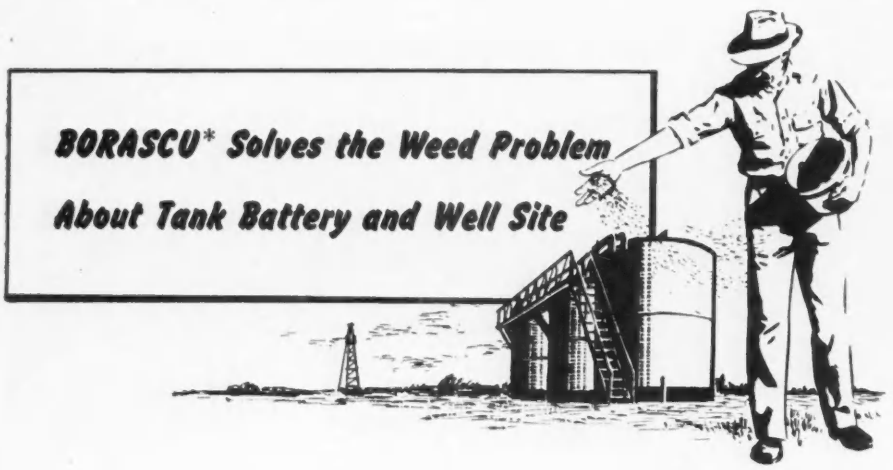
A. H. Anderson, 64, electrical foreman in the West Texas-New Mexico division for Humble Oil & Refining Company, died February 10 in Midland. He had been with Humble 29 years.

•

Ralph Dillenbeck, Tulsa independent oil man, died February 16.

•

J. Z. Hill, 70, retired purchasing agent for Gulf Oil Corporation, died January 23 in Houston. Hill went to work for Gulf in Beaumont in 1909 and moved to Houston in 1916 when the firm moved its headquarters there. He retired in 1945.



BORASCU* destroys weeds and grasses at a fractional cost of most methods such as hoeing, etc. You can enjoy substantial savings by using BORASCU* about *your* tank batteries, well sites, heater units, and rod lines, just as many other petroleum producers are now doing, for BORASCU* does destroy most vegetation and prevents future growth for 12 to 24 months, or longer, when correctly used! Borascu* and Concentrated Borascu are applied dry . . . if spray equipment is to be used, we suggest our new, improved Polybor-Chlorate for it is readily soluble and safe to use. Yes, it is nonfire-hazardous although it combines the plant-destroying powers of borates and chlorate . . . gives quick knockdown of tall standing vegetation. See these chemicals demonstrated on your property under your conditions without any obligation . . . act now!

*Reg. U.S. Pat. Off.

BORASCU WEED KILLER

NONCORROSIVE*
NONPOISONOUS
NONFLAMMABLE
NONSELECTIVE
ECONOMICAL

*To Ferrous Metals

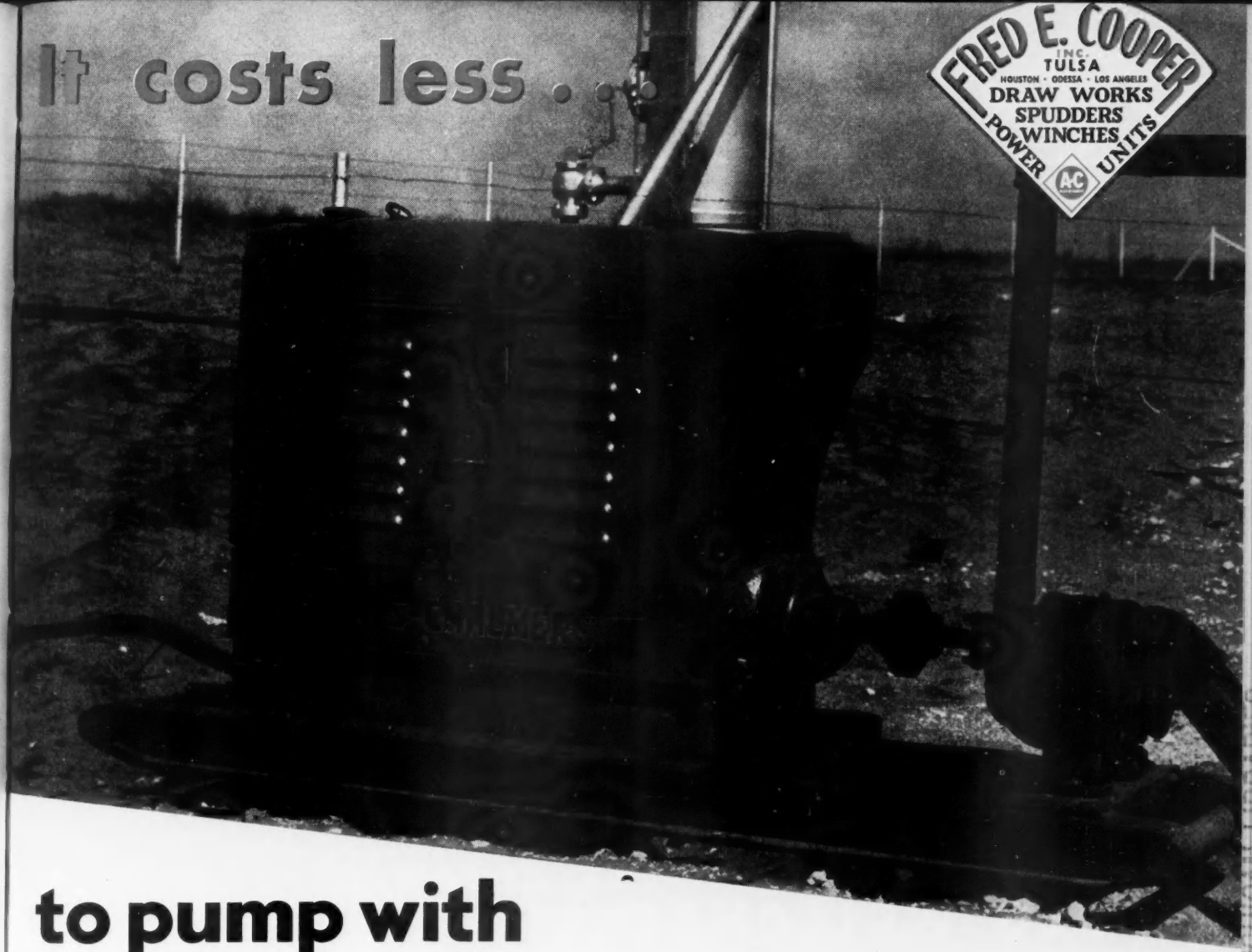
PACIFIC COAST BORAX CO.
DIVISION OF BORAX CONSOLIDATED, LIMITED

Weed Control Dept. Representatives located in the following cities: CHICAGO • NEW YORK CITY SEATTLE • PORTLAND, ORE. • CLEVELAND, OHIO • AUBURN, ALA. • MANHATTAN, KANSAS HOUSTON, TEX. • FT. WORTH, TEX. • SIOUX CITY, IOWA • BOZEMAN, MONT. • MINNEAPOLIS SAN FRANCISCO • Home Office: 510 W. SIXTH STREET, LOS ANGELES 14, CALIFORNIA

Order Your Copy of 1950 World Oil Index

The complete editorial index covering all issues of WORLD OIL published during 1950 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to all subscribers who write requesting copies.

Orders should be addressed immediately to the Circulation Department, Box 2608, Houston 1, Texas, as quantities are limited.



to pump with Allis-Chalmers Engines

- **One major oil company reports that a Model E Engine ran for 9 years, 10 months and 24 hours on round-the-clock continuous service before an overhaul.**
- **Another company reports a Model L Engine running continuously for more than 32,000 hours on a water injection pump before an overhaul.**

These examples reflect the rugged stamina built into all Allis-Chalmers Engines.

You get the advantage of more than 100 years experience by one of the world's largest manufacturers of power engines when you buy an Allis-Chalmers Engine . . . the engine that's built especially for heavy duty continuous work.

You can depend on Allis-Chalmers Engines . . .

"No Allis-Chalmers Engine is ever left an orphan." Cooper Sales-Service men are constantly on the job in every oil field to see that your Allis-Chalmers Engines give maximum service at less cost.

Allis-Chalmers Engines can be furnished complete, mounted with Rotary Pumps, Centrifugal Pumps, Reciprocating Pumps, or Generating Units. Let us figure your next installation.

FRED E. Cooper, Inc.

P. O. Box 1890 TULSA, OKLA.

Houston, Odessa, Los Angeles

Western Canada: Rocky Mountain Supply Co., Ltd., Calgary, Edmonton, Redwater.

Associations

Past and present officers of Petroleum Production Pioneers are, left to right, L. L. Aubert, new president; R. A. Broomfield, honorary president; R. E. Stearns, outgoing honorary president; and S. F. Bowlby, past president.

Production Pioneers Choose Aubert as Chief Executive

Petroleum Production Pioneers, Inc., Los Angeles, will be headed in 1951 by L. L. Aubert, Bankline and Norwalk Companies, as president. Others chosen by the group are R. A. Broomfield, retired executive of Barnsdall Oil Company, honorary president; A. E. Fowks, retired Union Oil Company executive, honorary vice president; Fritz Huntzinger, Ventura Tool Company, vice president; Paul E. Terry, The Capital Company, treasurer; R. Sneddon, The Petroleum Engineer, secretary; B. H. Anderson, Continental Oil Company, sergeant-at-arms; and Paul Andrews, Signal Oil & Gas Company, historian.

Geologists and Geophysicists Register for Manpower Plan

The National Security Resources Board, created under the National Security Act of 1947, is compiling a roster of technical manpower, called The National Scientific Register. The American Geological Intititute with headquarters in Washington is cooperating with NSRB through the help of local geological associations in registering all professional geophysicists and geologists. Purpose of this program is to correct many of the manpower requirements which were so ill considered at the outset of World War II. The National Scientific Register will be used by Scientific Advisory Committees in the Selective Service System. It is expected that these committees will review appeals for deferment which are made to the President, and that the information on file with the Register will be used in the consideration of such cases.

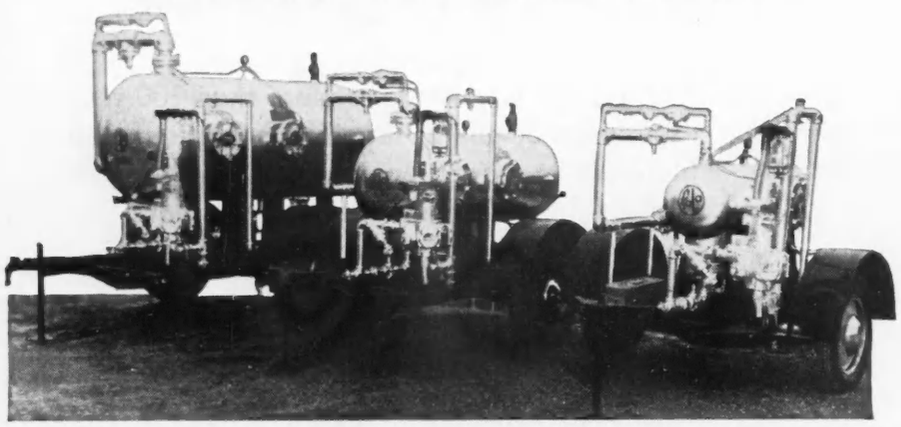
The National Security Resources Board, charged with the responsibility for the planning of general mobilization, both military and civilian, will use the information in determining the requirements for scientific manpower in various activities. The National Research Council and the American Geological Institute can determine the distribution and availability of earth scientists among the various specialized occupations. Government agencies may use the register to identify personnel with specialized training or experience for unusual work requirements. It will also prove valuable in the preparation of studies and recommendations to government agencies, such as the NSRB, concerning the needs for geoglogists and geophysicists in civilian occupations. This information will be used to determine the number of geological and geophysical personnel absorbed in the National Military Establishment and in the utilization of such personnel in the armed forces.

District committees have been established in 45 districts in the U. S. These committees have been set up through the cooperation of individuals and organizations, both national and local, who have made estimates on the number of geologists and geophysicists in each district. Franked envelopes are being sent to all members of the national societies so that each member may enroll for the Scientific Register.

The Thomas Committee, or technically known as the Scientific Manpower Advisory Committee of the National Security Resources Board, has been organized by NSRB to advise the Resources Board on matters related to the efficient utilization of scientific and technological personnel.

ROLO WELLCHECKERS

PERMANENT AND PORTABLE
OIL AND GAS SEPARATORS



Trailer-mounted Wellcheckers: 1H—3607, 1H—2406 and 1H—1607

Made in various sizes and working pressures to fit any operation, Rolo Wellcheckers enable the operator to check well production daily and to secure accurate tax and royalty records. Rolo Wellcheckers are shipped completely piped and ready to operate.

Write, wire or phone Rolo today regarding your well testing and oil metering requirements. See Composite Catalog or send for new illustrated Bulletin.

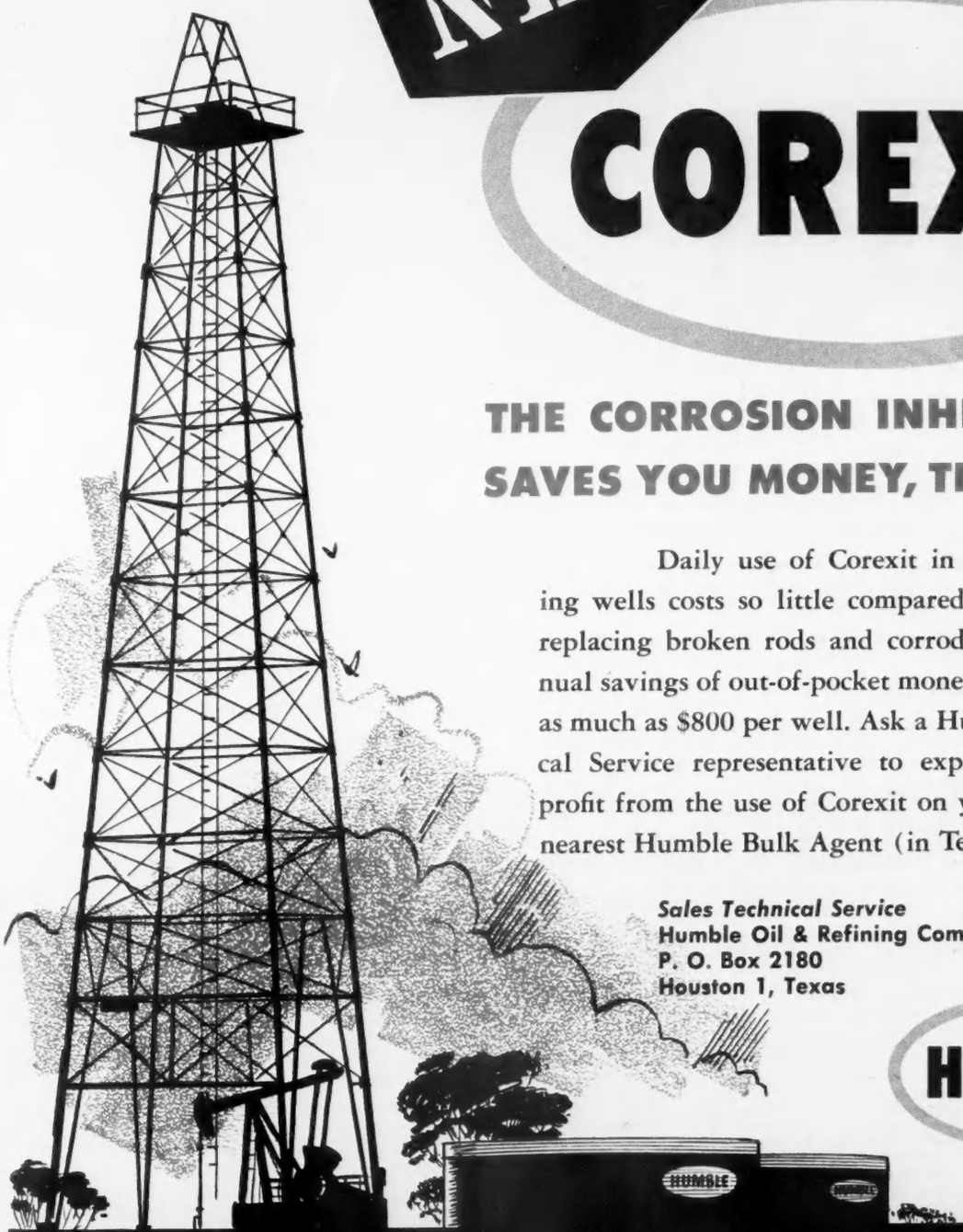
Crude Oil Metering Specialists

ROLO MANUFACTURING COMPANY

2510 South Blvd., Houston 6, Texas
BRANCHES: Corpus Christi, Midland, Kilgore, Tulsa, New Orleans, Los Angeles, Casper, Calgary (Alta.)
EXPORT OFFICE: R. S. Stokvis & Sons, Inc., Battery Place, New York, N. Y.

SAVES UP TO $800.
PER WELL • PER YEAR

NEW
COREXIT



THE CORROSION INHIBITOR THAT SAVES YOU MONEY, TIME, TROUBLE

Daily use of Corexit in sour crude, pumping wells costs so little compared to the expense of replacing broken rods and corroded tubing that annual savings of out-of-pocket money have amounted to as much as $800 per well. Ask a Humble Sales Technical Service representative to explain how you can profit from the use of Corexit on your lease. Call the nearest Humble Bulk Agent (in Texas) or write to:

Sales Technical Service
Humble Oil & Refining Company
P. O. Box 2180
Houston 1, Texas

HUMBLE

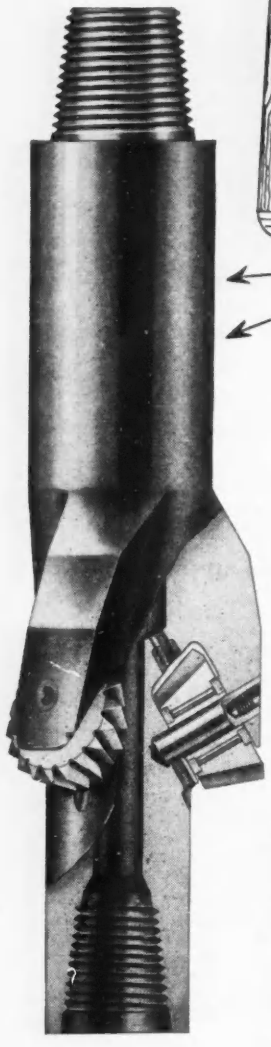
HUMBLE OIL & REFINING CO.

Petroleum Geologists Choose Morgan as 35th President

Frank A. Morgan, vice president and manager of exploration, Richfield Oil Corporation, Los Angeles, has been elected the 35th president of the American Association of Petroleum Geologists, succeeding C. L. Moody, The Ohio Oil Company, Shreveport. Other officers include: Lewis G. Weeks, Standard Oil Company (N.J.) New York City, vice president; Robert H. Dott, Oklahoma Geological Survey, Norman, Okla., secretary-treasurer; Kenneth K. Landes, University of Michigan, Ann Arbor, Mich., editor. The new officers will take over at the close of the 36th annual meeting of the AAPG to be held April 23-26 at St. Louis.

Materials Handling Meet Set

Sixteen chapters of the American Material Handling Society will participate directly in the program planned for the Materials Handling Conference which will be held concurrently with the National Materials Handling Exposition at the International Amphitheatre, Chicago, April 30 to May 4, inclusive. The society is sponsoring the conference and the Material Handling Institute is sponsoring the exposition.



Here's the tool you want for hole enlarging—a husky, fast-digging tool in *any* formation —the GRANT HOLE ENLARGER!

It's Rugged—three hard-faced cutters turn on big precision ball and roller bearings. Massive body and cutters are of heat-treated alloy steel.

It's Streamlined—designed to give maximum return circulation.

It's Self Cleaning—jetting action is directed against each cutter.

It's Fast—unique spiral cutter design eliminates tracking, insures complete and positive cutting action.

It's Economical—cutters are replaceable on the rig—an important time and money saver.

Write for Bulletin 38 giving full details and specifications —or see your Grant representative. Refer to the Grant Section in the Composite Catalog.

Proven Grant Tools—Used Where Performance Counts

Hydrostatic Bailers	Bulletin No. 11
Liner Pullers	Bulletin No. 14
Pressure Releases	Bulletin No. 15
Casing Scrapers	Bulletin No. 17
Underreamers (Rotary)	Bulletin No. 24
Underreamers (Cable Tool)	Bulletin No. 27
Hole Enlargers	Bulletin No. 38
Reamers	Bulletin No. 43
Hydrostatic Perforation Cleaners	Bulletin No. 50
Dump Bailers	Bulletin No. 51
Roller Cutter Shale Bits	Bulletin No. 54
Sand Pumps	Bulletin No. 55
Well Cleanout Equipment	Bulletin No. 57
Wall and Bottom Hole Scrapers	Bulletin No. 58

Write for Descriptive Bulletins on these Grant Tools

GRANT OIL TOOL COMPANY

Main Office and Plant
2042 E. Vernon, Los Angeles 11, Calif.
Branches Throughout California and The Mid-Continent

Subsidiary: MacClatchie Manufacturing Company

API Group Will Investigate Marine Role in Oil Formation

Detective work which may help to solve the mystery of the formation of petroleum deposits has been launched by the American Petroleum Institute. An intensive study, to be conducted for the Institute's Research Committee by the University of California, will probe the role of marine sediments in creating crude oil.

The remains of prehistoric marine animal and plant life buried in sedimentary rock strata generally are believed to be the source of oil formations, but no detailed scientific evidence exists as to how this conversion occurs. An understanding of the formation of oil would aid markedly in the location and development of new deposits.

Actual field work for the research project will be done by the Scripps Institution of Oceanography, La Jolla, Calif., a branch of the University of California, under the directorship of Dr. F. P. Shepard. The Scripps staff currently is laying preliminary plans and lining up personnel and equipment for the project. The Woods Hole Oceanographic Institution, Woods Hole, Mass., has agreed to assist Scripps in this investigation. Guif Coach institutions also are under consideration as possible participants in this study.

The API's Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum, one of two subcommittees of the Research Committee, will have over-all supervision of the study. L. E. Elkins, Stanolind Oil and Gas Company, Tulsa, is chairman of the Advisory Committee. The study, officially known as API Project 51—Study of Near Shore Recent Sediments and Their Environments in Northern Gulf of Mexico, will be under the direct supervision of a project committee headed by A. R. Dennison, Amerada Petroleum Corporation, Tulsa.

Texas Independents Will Hold Annual Meeting in Beaumont

Representing part of the year-long celebration of the 50th Anniversary of the Spindletop discovery, Texas Independent Producers and Royalty Owners Association will hold its annual meeting in Beaumont, Texas, March 27-28.

The meeting will begin Tuesday, March 27, with the gathering of all standing committees to compile reports for the membership. The following day delegates representing the approximate 5000 association members throughout the state will meet in morning and afternoon business sessions, a membership and ladies luncheon, with the convention culminating in the annual dinner.

Directing arrangements for the meeting will be local committees headed by Randolph C. Reed, general chairman.

Heads Industrial Department

Charles F. Alexander has been named manager of the Industrial department of the National Safety Council. Alexander has had extensive experience in the fields of production, engineering, foreman training and sales, and was most recently assistant general manager of manufacturing for Cherry-Burrell Corporation, Chicago.

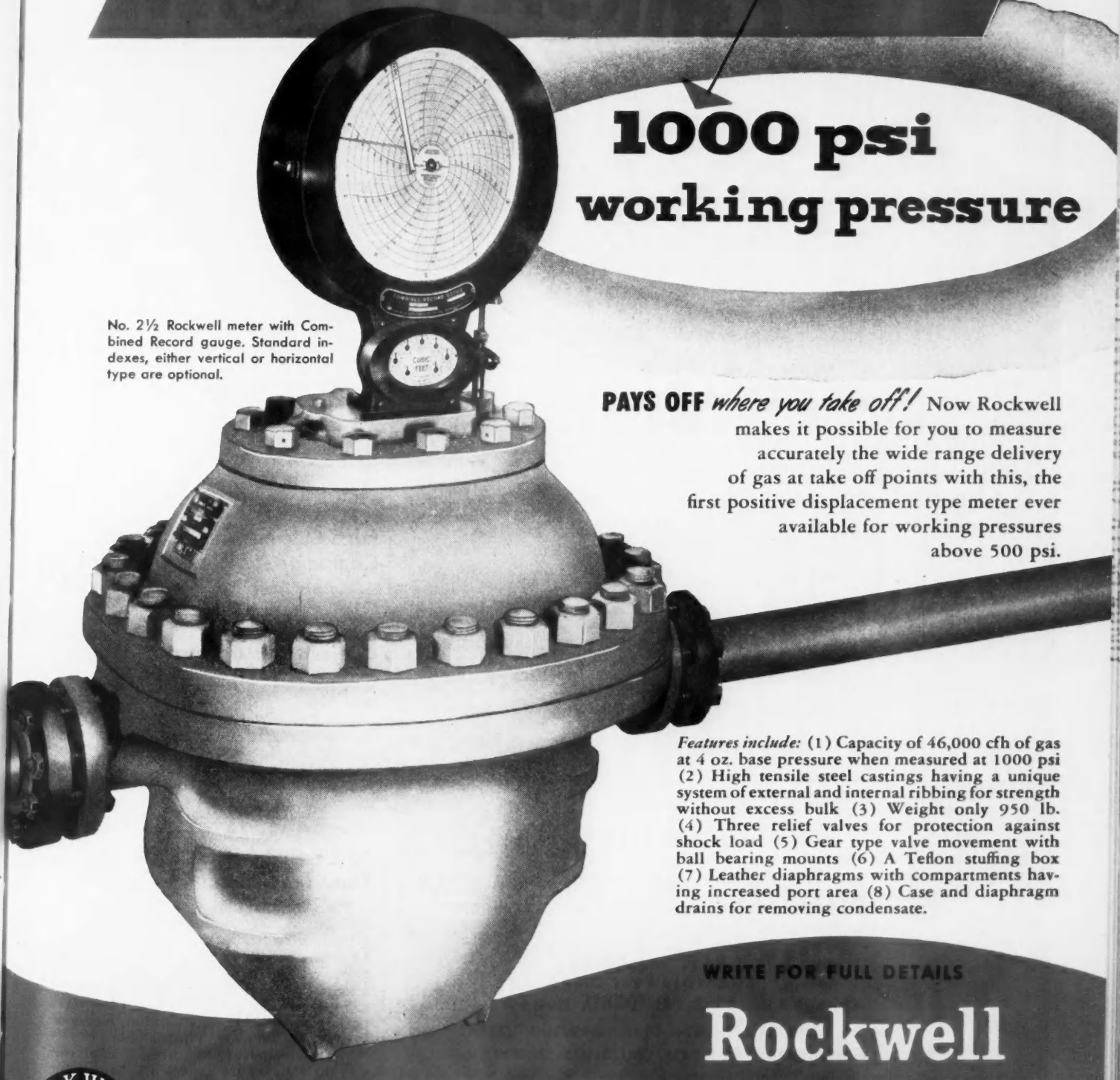
IT'S NEW!

ROCKWELL

No. 2½ Positive Displacement Gas Meter

FOR TAKE-OFF SERVICE

1000 psi working pressure



No. 2½ Rockwell meter with Combined Record gauge. Standard indexes, either vertical or horizontal type are optional.

PAYS OFF *where you take off!* Now Rockwell makes it possible for you to measure accurately the wide range delivery of gas at take off points with this, the first positive displacement type meter ever available for working pressures above 500 psi.

Features include: (1) Capacity of 46,000 cfh of gas at 4 oz. base pressure when measured at 1000 psi (2) High tensile steel castings having a unique system of external and internal ribbing for strength without excess bulk (3) Weight only 950 lb. (4) Three relief valves for protection against shock load (5) Gear type valve movement with ball bearing mounts (6) A Teflon stuffing box (7) Leather diaphragms with compartments having increased port area (8) Case and diaphragm drains for removing condensate.

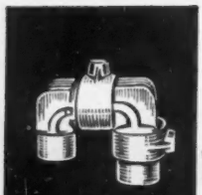
WRITE FOR FULL DETAILS

Rockwell

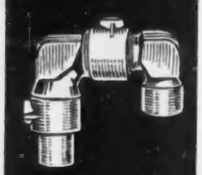
MANUFACTURING COMPANY

PITTSBURGH 8, PENNSYLVANIA

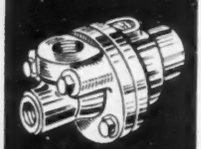
Atlanta Boston Chicago Columbus Houston Kansas City
Los Angeles New York Pittsburgh San Francisco Seattle Tulsa



Standard Swivel Joints
For pressures from 125 psi to 15,000 psi.

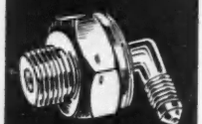


High Temperature Swivel Joints
For temperatures to 600° F. M.W.P. 300 psi.



Rotating Joints
For 150-lb. steam, brine, etc.

Sanitary Swivel Joints
For Food Processing, Dairies, etc.



Hydraulic Swivel Joints
For pressures to 3,000 psi.

DESIGN

There is No Substitute for Experience CHIKSAN

MANUFACTURE

APPLICATION

Only with CHIKSAN ***Ball-Bearing*** Swivel Joints* can you benefit from a quarter-century of ***specialized experience*** in the development, design, manufacture and application of Swivel Joints for all purposes. CHIKSAN'S resources, facilities and personnel are ***concentrated exclusively*** on the production of Swivel Joints and their application to all kinds of installations. This is your assurance of efficient performance, long life and low-cost maintenance. There is no substitute for CHIKSAN!

CHIKSAN Engineers will gladly cooperate with you in selecting the correct Types and Styles of Swivel Joints for your particular requirements...and in specifying the proper Packing Unit for the fluid you handle. This valuable, experienced counsel costs you nothing.

*For full 360° rotation in 1, 2 and 3 planes. Unlimited flexibility in pipe lines can be secured simply by arranging swivels in proper sequence.

WRITE FOR CATALOG NO. 50

Representatives in Principal Cities
Sold by Leading Supply Stores Everywhere

CHIKSAN TRADE MARK REG.

CHIKSAN COMPANY
AND SUBSIDIARY COMPANIES
Chicago 3, Ill. BREA, CALIFORNIA Newark 2, N. J.
WELL EQUIPMENT MFG. CORP. HOUSTON 1, TEXAS
CHIKSAN EXPORT CO. BREA, CALIFORNIA NEWARK 2, N. J.

BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES

ASSOCIATIONS

Penn Grade Association Forms Technical and Business Groups

C. E. Streeter, president of the Pennsylvania Grade Crude Oil Association, announced the formation of two subcommittees to streamline the handling of technical and fiscal matters growing out of the Association's investigation of scientific methods to improve the recovery of petroleum from fields in which artificial pressures are employed to drive the oil to producing wells.

The association's research advisory committee henceforth will consist of two groups, a technical subcommittee of ten men, comprising engineers and geologists from leading Pennsylvania oil producing companies and educational institutions who are recognized authorities on the production of oil by secondary recovery, and a business subcommittee of nine men consisting of executives of Pennsylvania oil producing and refining companies who also are association directors.

Kansas University Schedules Natural Gas Lecture Series

A two-day course in natural gas engineering will be conducted March 26-27 at the University of Kansas, Lawrence, Kansas, by Dr. Donald L. Katz, professor of chemical engineering at the University of Michigan. Subjects included in the series are physical and thermodynamic properties of natural gas, flow of natural gas in pipes, flow of gas in reservoir, and prediction of gas reserves.

The course is sponsored jointly by the Department of Petroleum Engineering of the University of Kansas, the State Board of Health, Kansas Section of AIME, Kansas State Geological Survey, and the University of Kansas Extension.

OIIC Expands Advertising Campaign for Wider Coverage

The API Oil Industry Information Committee is expanding its advertising campaign in 1951 to reach a larger percentage of the American people and at the same time to give increased support to its rapidly growing field organization of 15,000 district, state, area and community committeemen.

The Committee's 1951 ads will appear on the average of once a week in a major publication. Twenty magazines and newspaper supplements having a total circulation of 46,961,267 will run the advertisements.

NACE Committees Complete Plans for General Conference

Plans for the 1951 Conference and Exhibition of the National Association of Corrosion Engineers, to be held March 13-16 at the Statler Hotel in New York City, have been completed by the General Conference Committee and Local Arrangements Committees. The committees were presided over by H. L. Hamilton, Keystone Pipe Line Company, Philadelphia.

Approximately 1200 corrosion engineers and their guests are expected to attend the conference.

Officers of the Houston Chapter of Nomads are, front row, left to right, E. F. Baldwin, secretary-treasurer; Wayne Rives, president; E. H. Lorehn, regent; Jay Speece, deputy sergeant-at-arms. Second row: Tracy Word, Jr., regent; Herschel Wood, vice president; Larry Kelley, assistant secretary-treasurer; Bob Franklin, sergeant-at-arms; and Harry Estes, executive secretary.

Compact Commission to Meet April 26-28 in New Mexico

Governor Allan Shivers of Texas announced that the spring meeting of the Interstate Oil Compact Commission will be held April 26-28 in the La Fonda Hotel, Santa Fe, N. M.

This was Governor Shivers' first official act since being elected chairman of the Compact Commission for 1951 at the recent meeting of the Commission in Houston.

Hotel accommodation requests should be directed to the headquarters office of the Commission, Box 3127, State Capitol, Oklahoma City 5.

Management Institute Honors 12 U. S. Petroleum Companies

Twelve companies in the petroleum industry are among 238 firms throughout the U. S. and Canada which are being awarded "Certificates of Management Excellence" for the year 1950 by the American Institute of Management, New York. The awards, which will be bestowed annually hereafter by the Institute, are based on its continuing study of more than 2000 leading concerns—designed to provide a base for research into corporate policies and procedures.

The twelve honored companies include Cities Service Company, New York; Continental Oil Company, Ponca City, Okla.; Gulf Oil Corporation, Pittsburgh; Humble Oil & Refining Company, Houston; The Ohio Oil Company, Findlay, Ohio; Phillips Petroleum Company, Bartlesville, Okla.; Socony-Vacuum Oil Company, Inc., New York; Standard Oil Company of California, San Francisco; Standard Oil Company (Indiana), Chicago; Standard Oil Company (N. J.), New York; The Standard Oil Company (Ohio), Cleveland, and Sun Oil Company, Philadelphia.

Conference on Increased Oil Recovery Planned by College

The second conference on Increased Recovery of Oil will be held April 19-20 at the Student Union Building of Texas A. & M. College, College Station. The conference is conducted by Texas Petroleum Research Committee as part of its research program. Paul D. Torrey, Houston, is general chairman, and Walter D. Rose, assistant director of the committee, is program chairman.

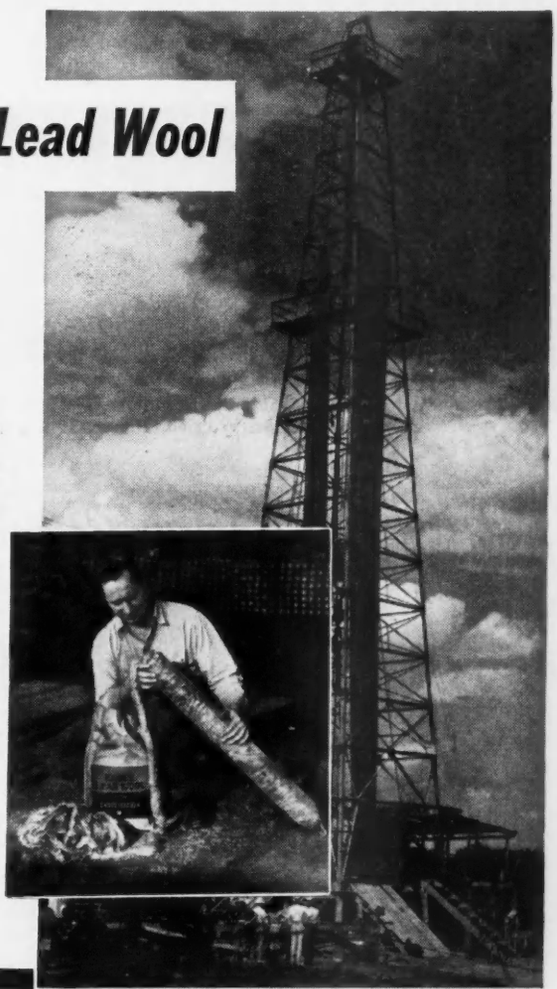
A feature of the conference will be a symposium on "Carbonate Reservoirs" to summarize what is known about the origin, geology, physical properties and performance of limestone and dolomite reservoirs.

Eagle-Picher Lead Wool

STOPS

bottom water

Rule out the risk of oil-wasting bottom water shutdown by tamping Eagle-Picher Lead Wool in the hole. The finely stranded, flexible metallic wool makes a water-tight plug that seals every crack and crevice. Comes in convenient 50-pound sacks—easy to place in special cartridge-shaped Eagle-Picher Wire Containers sized to fit all casings. Order through your jobber.



THE EAGLE-PICHER SALES COMPANY

Since 1843

Metallic Products Division,
General Office, Box 777
East Chicago, Indiana

Cincinnati · Kansas City
East St. Louis · Dallas · Houston

Member: Lead Industries Association

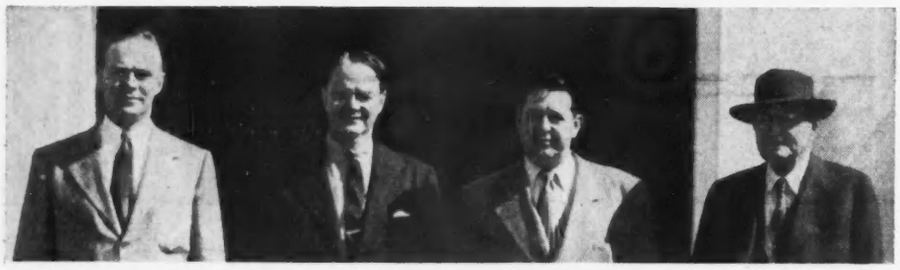
2065-LW

EAGLE EP PICHER

These **3** *Eagle-Picher Bearing Metals meet most requirements*

1. **Dreadnaught** — for extreme speed and heavy-duty conditions.
2. **Outlasta** — for medium speed and average-load conditions.
3. **Durable** — for low speed and light-duty conditions.

EQUIPMENT AND SERVICE SUPPLIERS' NOTES



Executives of Mission Manufacturing Company are, left to right, Dudley C. Sharp, president; W. Bedford Sharp, board chairman; W. T. Campbell, vice president and sales manager; and Ed Prather, treasurer.

Sales personnel of Mission Manufacturing Company are pictured at the company's annual sales meeting. Mission is celebrating its 25th anniversary this year.

Mission Manufacturing Organization Observes 25th Business Anniversary

Mission Manufacturing Company, Houston, a leading maker of oil field equipment, is celebrating its 25th anniversary throughout 1951. The company was started in December, 1925, as Mission Sales Company, functioning as sales agent for a line of oil field equipment and supplies.

In October, 1932, the company was reorganized as Mission Manufacturing Company, for the purpose of manufacturing and selling oil field specialties. W. Bedford Sharp was president, Dudley C. Sharp vice president and general manager, W. T. Campbell vice president and sales manager, and A. M. Foute secretary and office manager. A small machine shop on Railroad Avenue in Houston was its first plant. In March, 1935, the company moved into its present plant on Humble Road. The main office building of this plant is built in the architectural style of the old Spanish missions. Extensive additions have been made to the plant since 1935.

Mission's principal products are slush pump pistons, piston rods, liners, valves and self-sealing packings; "Rolling Dog" rotary, tubing and casing slips; tubing swabs, plug valves, and "Streamlined Flow" centrifugal pumps.

Guier Will Continue as President Of Unit Rig & Equipment Company

Ken W. Davis, Fort Worth, who recently purchased the entire stock of Unit Rig & Equipment Company, Tulsa, announced that William Guier, president of the company, will remain in that capacity. No changes in personnel or policy are contemplated.

William Guier

The purchase, according to a company announcement, was an expansion move which will enable Unit Rig to add facilities for production and distribution of oil field equipment and ditching machines.

United Geophysical Company Names Martin to Foreign Operations Post

L. A. Martin has been appointed manager of foreign operations for United Geophysical Company, Inc., with headquarters in United's Pasadena, Calif., office. His duties include supervision of all South American and Middle Eastern crews. Martin is now on an inspection trip of all United crews in Venezuela, Brazil and Chile.

E. J. Marti has been named supervisor of operations for United in the Middle East area. Marti has had many years experience in geophysical exploration both domestic and foreign. His new headquarters are in Kuwait on the Persian Gulf.

"The Greatest Name in Cable Tools..."

Acme

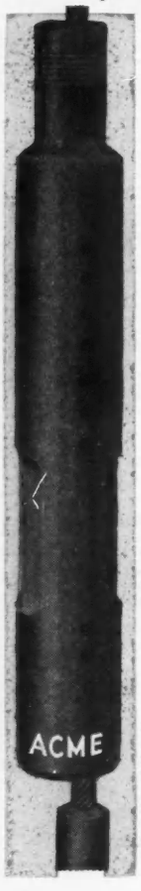
TRUSTWORTHY SINCE 1900

PETROLEUM EQUIPMENT SUPPLIERS MEMBER ASSOCIATION

. . . to-be-Sure—Always Ask for Acme's Rope Sockets

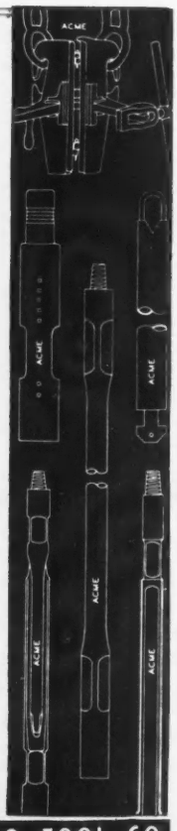
It's what's underneath that counts most — downhole. Acme Rope Sockets have inner-RUGGED qualities—a ½-century's worth — that pay off, in bonus service. From billet to finished socket, its every field-service factor is safe-guarded: By our rigid PREMIUM-grade steel specifications; electromatic controlled heat-treatment, and toolmanship to engineered precision.

Prosser Swivel Socket (illustrated) is used on Wire Cable; as are Babcock (stiff) and Burns Swivel. Made to API specifications (unless "special"). All must enhance the Acme tradition — for TRUSTWORTHY performance: "Down-deep" tool-qualities that aren't "stop-watch" limited; qualities that cut drilling cost foot-by-foot.



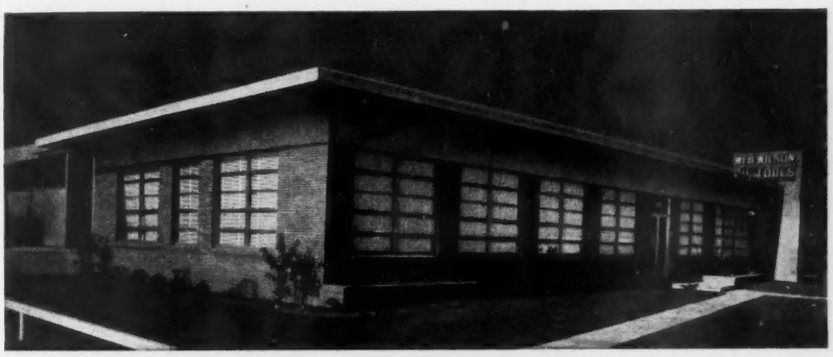
See Acme's Insert in 1951 Composite Catalog. Also write for more complete Catalog, containing valuable cable tool "use and care" manual.

Fig. 115 — Acme Prosser Swivel Socket. 51-yrs' specialized "know-how" makes it worth more to YOU.



ACME DRILLING & FISHING TOOLS

ACME FISHING TOOL CO.
PARKERSBURG W. VA.
Export Office:
19 Rector St., New York 6, N.Y.



The New Offices of Web Wilson Oil Tools, Inc., at 14905 South San Pedro Street, Los Angeles, house the administrative, engineering and general office staffs. Various new products, including a line of production tools, are being introduced as a result of expanded facilities.

Lane-Wells Company Purchases Stock In Tulsa Well Surveys Organization

Lane-Wells Company has purchased 50 percent of the capital stock of Well Surveys, Incorporated, Tulsa. The remaining half of Well Surveys' stock is owned by Socony-Vacuum Oil Company, Inc.

Well Surveys was formed in 1939 to engage in the development and exploration of radioactivity well logging techniques and equipment. Lane-Wells has been the principal licensee under Well Surveys patents and has performed more than 30,000 well logging operations since the service was introduced in 1940.

Rodney S. Durkee, president, and Dr. Russell M. Otis, manager of research and patent department of Lane-Wells, have been elected directors of Well Surveys. Other members of the board are Willis W. Hardy of Socony-Vacuum; Henry Cortes of Magnolia Petroleum Company; and W. G. Green, president of Well Surveys.

Officers of Well Surveys, Incorporated, are Charles E. Duller, vice president and treasurer; Robert K. Schumacher, secretary; and E. B. Clemons, assistant secretary.

Lee Laird Joins Baash-Ross Company As Sales Manager for California

Lee J. Laird has joined Baash-Ross Tool Company as California sales manager. Laird has been associated with the oil industry more than 22 years. He was formerly with Chiksan Company as vice president and general sales manager, a post he left to devote full time to his own company, the Gil-Lair Products Corporation. His new headquarters are at the main Los Angeles plant of Baash-Ross Tool Company.

Lee J. Laird

Laird is a past president and senior regent of the Los Angeles Chapter of Nomads, and secretary-treasurer of the national board of regents. He is also a junior member of the Petroleum Production Pioneers.

Cleco Distributor Is Appointed

The Cleco Division of Reed Roller Bit Company, Houston, has appointed Montes y Valles, S.A., Vallarta 1-305B, Mexico 4, D. F., as distributor of Cleco products in that area. In addition to handling the full line of Cleco pneumatic tools, Montes y Valles will maintain complete stocks of Cleco parts and accessories.

For ECONOMICAL, LONG-LASTING PROTECTION of Equipment and Property

You'll find Pitt Chem Cold Applied Tar Base Coatings ideal for a wide variety of protective jobs. Made from coal tar pitch, one of nature's most impervious protective materials, they're easy to apply, relatively low in cost, and effective against most corrosion conditions.

The uniform top quality of Pitt Chem Cold Applied Tar Base Coatings is assured by the close production control which results from our completely integrated manufacturing operation. If you're looking for an economical, dependable way to add years of service to your plant's physical assets, see your nearest Pitt Chem man . . . or write for new booklet, "Control Corrosion through Pitt Chem Protective Coatings".

PITT CHEM
Industry's Most Comprehensive family of Protective Coatings

- ★ Hot Applied Tar Base Coatings
- ★ Cold Applied Tar Base Coatings Series 100
- ★ Alkyd Base Coatings—Series 200
- ★ Chlorinated Rubber Base Coatings—Series 300
- ★ Vinyl Base Coatings—Series 400
- ★ Phenolic Base Coatings—Series 500

See Your Nearest Pitt Chem Man

PROTECTIVE COATINGS DIVISION

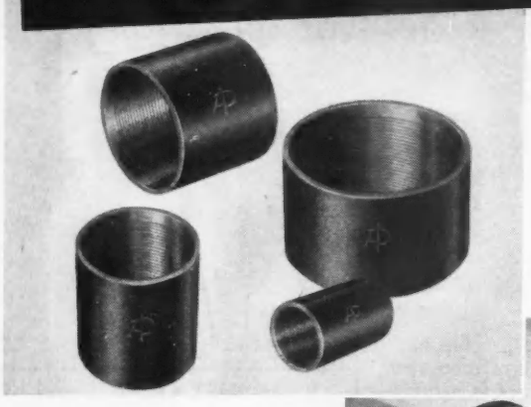
W & D 3480

PITTSBURGH COKE & CHEMICAL CO.
GRANT BUILDING, PITTSBURGH 19, PA.

OFFICES: New York • Chicago • St. Louis • Tulsa • Houston • Los Angeles • San Francisco

The One Millionth Barrel of Shell Brand Cement was loaded for shipment in a brief ceremony in Corpus Christi, Texas. Shown on the packhouse loading platform discussing the event are, left to right, Marshall Clements, sales manager for Halliburton Portland Cement Company; A. J. Anderson, works manager; and Ellroy King, vice president. The ceremony also marked the tenth month of operation of the company's Corpus Christi plant.

The Always-Dependable Source for Couplings and Flanges is
HARRISBURG STEEL CORPORATION



HARRISBURG Seamless Steel Pipe Couplings are made to A.P.I. and A.I.S.I. specifications.

HARRISBURG Drop-Forged Steel Pipe Flanges are manufactured to A.S.A. standards.

Consult our Oil Country Distributors or write Harrisburg for information

SEE OUR CATALOG IN THE COMPOSITE CATALOG

HOUSTON: Henry H. Paris, Distributor, Inc.
LOS ANGELES: Howard Supply Company
Republic Supply Co. of California
TULSA: W. C. Norris, Manufacturer, Inc.

HARRISBURG STEEL CORPORATION
Harrisburg 8, Pennsylvania

Custom-Built Quality Products in Quantity
98 YEARS IN PENNSYLVANIA'S CAPITAL

Llanso Is Appointed Worthington's General Manager for All Exports

J. J. Llanso has been appointed general export manager of Worthington Pump and Machinery Corporation. Since 1947 Llanso has been a vice president and manager of Worthington, Ltd., Buenos Aires, Argentina.

J. J. Llanso

Upon graduation from the Massachusetts Institute of Technology with a B. S. degree in mechanical engineering in 1929, he joined the Worthington Student Training Course. He has been with the Export department of Worthington ever since, serving 13 years in South America. He was resident engineer, first in Buenos Aires from 1936 to 1942, and later in Lima, Peru, from 1944 to 1945. He then became acting manager of Worthington do Brasil, Ltd., Rio de Janeiro, until 1946 when he returned to the Buenos Aires office.

National Supply Company Appoints Three District Credit Managers

Three new district credit managers have been appointed by the Treasury department of The National Supply Company.

Earl M. Mulvaney will open a new credit office at Odessa, Texas, where he will supervise the areas of West Texas and Southeastern New Mexico. Mulvaney has been with National Supply since 1920 and has worked for the company in Kansas, Michigan, and Casper, Wyo. He attended Kansas State Normal and Baker University.

At Casper, Harry C. Crumley will take over the office which covers Wyoming, Montana, Utah, Colorado, western Nebraska, and northwestern New Mexico. Crumley joined the company in 1948 after leaving the Fidelity Trust Company in Pittsburgh. A vetetran of the U. S. Army Air Forces, he moves to Casper from the Illinois district where he was a credit representative.

Arthur L. Wallace, formerly chief clerk in the division credit office at Fort Worth, Texas, moves to Olney, Ill., as credit manager for the district which is comprised of Illinois, Indiana, and western Kentucky. After four years service with the U. S. Army, Wallace was assistant credit manager of a Tulsa bank and joined National Supply in 1947. He attended Tulsa University.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Graham Will Handle Mid-Continent Sales of Pacific Plunger Pump Line

Appointment of G. F. (Bill) Graham, as sales manager, Mid-Continent division Pacific Pumps, Inc., to handle Pacific's oil well plunger pump line, was announced by Roy A. Dunbar, President of the Mid-Continent Division of Pacific Pumps, Inc.

G. F. Graham

Graham, whose headquarters will be 1221 East First Street, Tulsa, has had 27 years of experience selling oil well plunger pumps in the area. For the past 17 years Graham has been with the Mid-Continent division of Pacific Pumps and his experience in the industry includes work in the Texas, Arkansas and Louisiana fields. For the past several years Graham has been district manager of Pacific's northern division, including Kansas, Illinois and the Rocky Mountain fields.

Howard Pape, H. K. Porter Company Vice President, Resigns Position

Howard Pape, vice president of the H. K. Porter Company, Inc., announced his resignation. Pape joined the Jarecki Manufacturing Company as vice president and director in charge of operations in March, 1945. He transferred the company's headquarters to Houston and this company was purchased by the H. K. Porter Company in July, 1949. Jarecki then became a division of the parent company at which time Pape was made a vice president of the H. K. Porter Company.

Pape has been associated with the oil industry and the supply and manufacturing business for the past 30 years.

Emsco Promotes Basquez to Manager Of Sales Promotion and Advertising

Appointment of George Basquez as sales promotion and advertising manager was announced by Emsco Derrick & Equipment Company. He took over the post held by E. B. (Ernie) Fowks, when the company moved its advertising and sales promotion offices from Los Angeles to Houston.

George Basquez

Basquez has had a varied experience in drilling, production, manufacturing and sales, interrupted by 4½ years in the army. For four years after leaving the University of Texas, where he majored in geology, Basquez worked for Shell Oil Company, leaving to enter the service. On his return from overseas he joined the Emsco organization in Houston. Immediately prior to his appointment as sales promotion and advertising manager he was city salesman for Emsco in Houston, Corpus Christi and New Orleans.

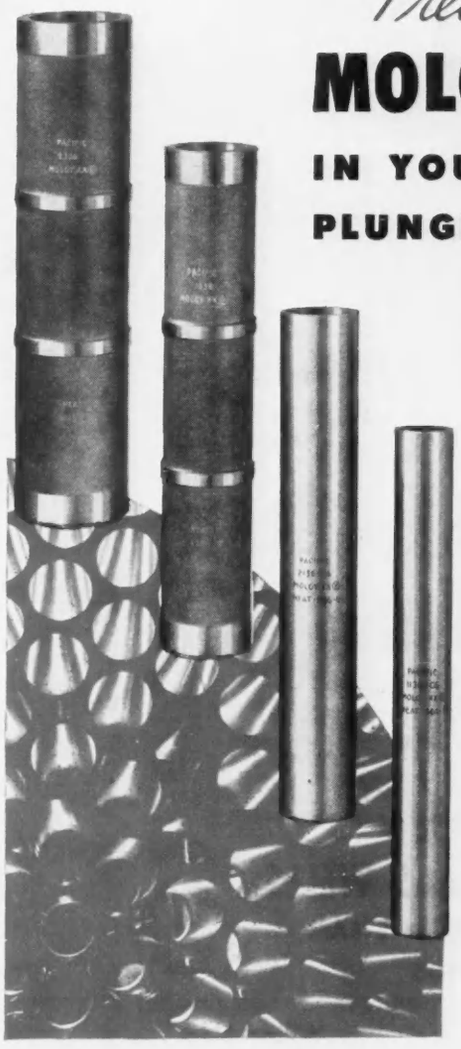
DECREASE YOUR COST OF PRODUCTION SIMPLY INSTALL

Pacific

Precision Built

MOLOY ® LINERS

IN YOUR OIL WELL PLUNGER PUMPS



MOLOY—® a ferrous alloy developed by Pacific primarily for oil well plunger pump liners has all the qualities for long economical life in your well. Strength, toughness, hardness combined, give MOLOY greater resistance to temperature, corrosion and abrasion than ordinary iron liners.

MOLOY—® LINERS are precision controlled at every step from the electric furnace to the final heat treatment to insure perfect castings of uniform chemical and physical characteristics.

MOLOY—® LINERS are precision finished to extremely narrow tolerances. You receive the full benefit of this precision finish because the uniform structure and, above all, the stability of MOLOY ® prevents the liners from warping after machining operations are completed.

IN FIELD AFTER FIELD, THE STRENGTH AND DURABILITY OF MOLOY—® LINERS HAS REDUCED PRODUCTION COSTS AS MUCH AS 50%

PACIFIC *Precision Built* PUMPS

Pacific Pumps inc.

ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIF.
MID-CONTINENT DIVISION
1221 E. 1st St., Tulsa, Oklahoma
Export Office: Chanin Bldg., New York
Offices in all Principal Cities

Allis-Chalmers Subsidiary Acquires Canadian Allis-Chalmers Concern

The purchase of all the physical assets of Canadian Allis-Chalmers, Ltd., by a new wholly owned subsidiary of Allis-Chalmers Manufacturing Company of Milwaukee was announced by the parent concern. The new subsidiary is known as Canadian Allis-Chalmers (1951) Limited.

The Canadian firm, which employs approximately 525 people, will continue the production of heavy machinery for the Canadian market. M. C. Lowe, formerly vice president of Canadian Allis-Chalmers, Limited, has been named president of the new Allis-Chalmers subsidiary.

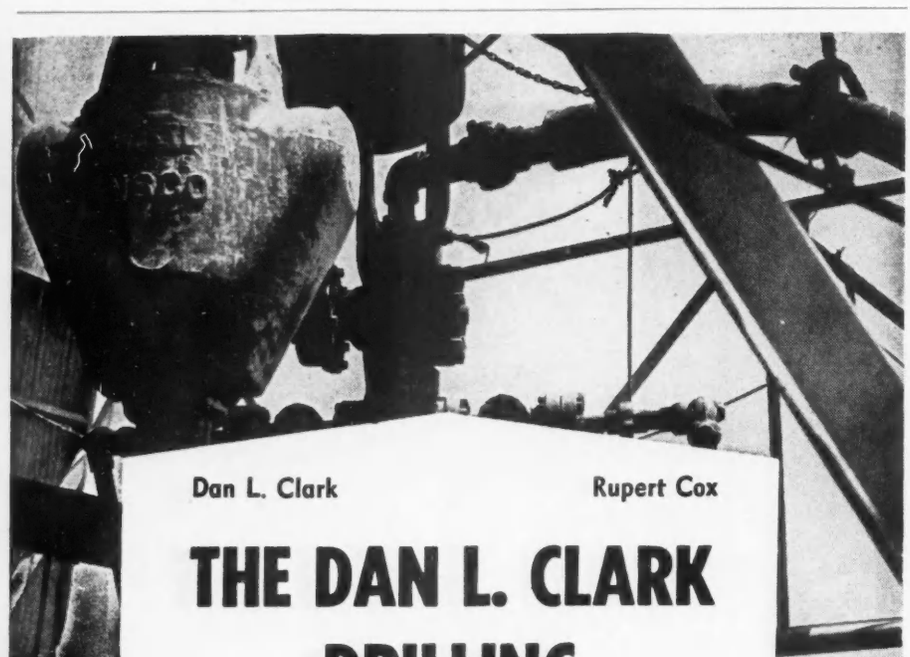
Included in the purchase was 17 acres of land at Lachine, Quebec, on which there are five buildings. These comprise welding, machine and pattern shops as well as a pattern storage building and an office building.

Worthington's New Oil City Works Assigned Overflow of Other Plants

Sale of the plant and equipment of National Transit Pump and Machine Corporation, Oil City, Penn., has been completed and Worthington Pump and Machinery Corporation has taken possession of its facilities. The miscellaneous overflow from Worthington's other factories will be diverted to the Oil City plant, according to Austin C. Ross, vice president in charge of Worthington's Buffalo plant, who will also have administrative charge of the plant here.

William F. Weinreich, formerly assistant superintendent of Worthington's Buffalo machine shops, will be in charge at Oil City as assistant to the vice president.

The former Transit plant here which covers 500,000 square feet, includes iron, steel, and brass foundry, pattern shop and forge shop, machine shops and assembly floor, test facilities, power house, steel fabricating shop and administration building.

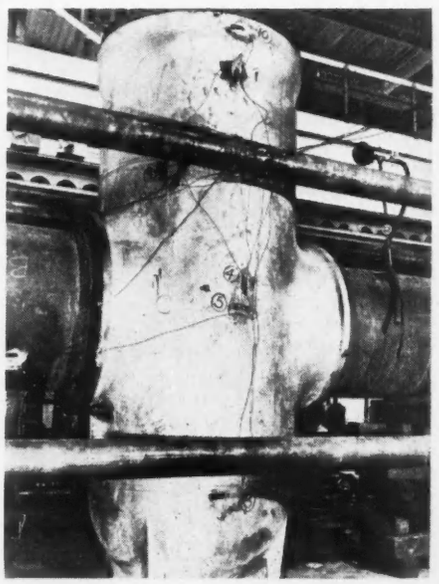


W-K-M Company Installation Tests Strain on Pipe Line Gate Valves

To simulate the effects of forces developed by the expansion and contraction of pipe lines on their gate valves in field service, W-K-M Company, Houston, designed a huge fixture with a built-in two-way hydraulic loading cylinder capable of applying tension and compression up to 1 million pounds on valves as large as 30 inches or more.

Under loads exceeding those expected in service the strains were measured at critical points on the valve body. Also, the operation of the gate and valve stem was observed and the leak resistance of the valve was checked under load. Tests were made under external loads of 675,000 pounds with and without internal hydraulic pressure of 850 pounds per square inch.

In contrast to the size of the valves and loading equipment, strains in the valve body were measured by means of postage-stamp-size resistance wire strain gauges bonded to the exterior surface of the valve at points where maximum strains were expected. Ten strain gauges were used in the tests of a 30-inch Weld End Rising Stem W-K-M Gate Valve.



The arrangement of ten SR-4 strain gauges and wiring on a 30-inch W-K-M gate valve for simulated service tests is shown by this close-up. Gauge No. 2 is above to the right of gauge No. 3. Gauges 6 and 7 are on the opposite side of the valve body from gauges 4 and 5. Gauges measure strain in the direction of their long axis of the gauge.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Patterson-Ballagh Division Names Mageors to Snyder Area Sales Staff

J. P. Magoffin, general sales manager of Patterson - Ballagh division of Byron Jackson Company, has named Robert P. Mageors to be located in Snyder, Texas. Mageors will be assistant to Gene Mitchell, who is in charge of PB sales and service for the Snyder area. Mageors has had extensive oil field experience, including work with major producing companies.

R. P. Mageors

Pelton Assigns Woodard New Duties As Manager at Los Angeles Factory

C. J. Woodard, manager of the Oil Industry Machinery division of Pelton Water Wheel Company, has assumed the added duties of plant manager of the Los Angeles factory, which includes supervision of engineering, manufacturing, sales and service on all Pelton products manufactured there.

C. J. Woodard

Woodard joined the Pelton organization as an engineer in the Hydraulic Turbine and Valve division. He was later assigned to the development and marketing of Long stroke hydraulic pumping equipment. He attended Stanford University and California Institute of Technology, and during World War II he served three years in the Navy.

Ozanne Joins Herold Organization As Vice President and Editor

Henry Ozanne has joined John S. Herold, Inc., of 250 Park Avenue, New York City, as vice president and editor of the monthly publication, *Oil Industry Current Notes and Comment*. The Herold corporation offers geologic and economic technical services to the petroleum industry and in the financial field.

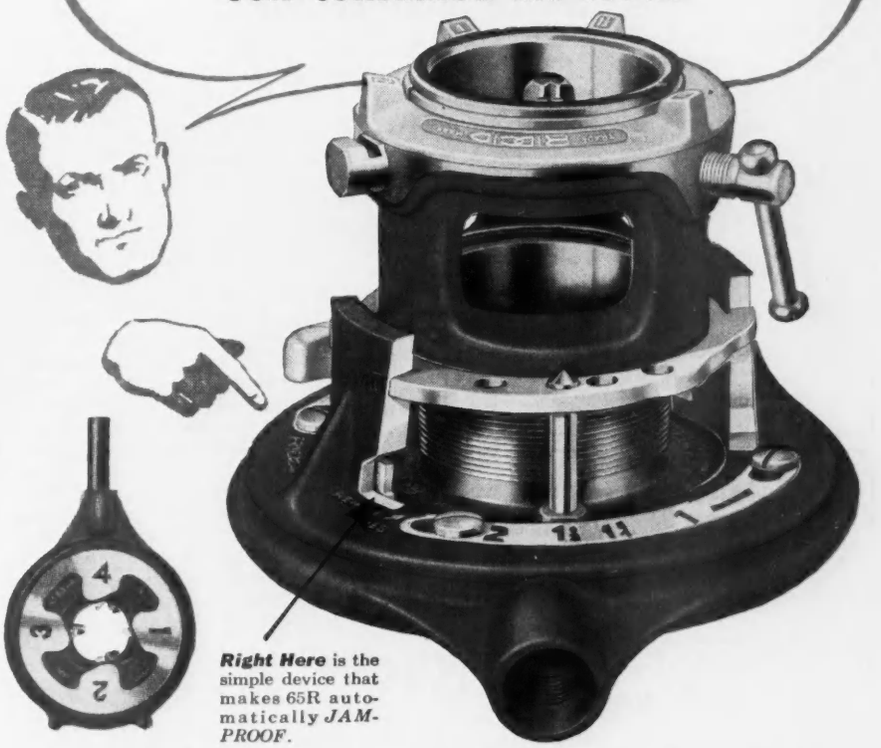
Ozanne in the past has been connected with several oil industry trade publications, including World Oil. On joining the Herold organization, he remains president of Petroleum Industry Projects, publisher of the "Oil Record" and other monographs in the oil industry.

Continental Supply Names Managers

Continental Supply Company has appointed Oliver C. Davis store manager of its Artesia, Colo., branch. Other recent appointments are those of Billie R. Riggs as manager of the Brookhaven, Miss., branch store, and G. N. Frost as manager at Jena, La. Frost was formerly store manager at Brookhaven.

You can't jam the new RIDGID 65R

Really streamlined pipe threading with this RIDGID self-contained die stock



Right Here is the simple device that makes 65R automatically *JAM-PROOF*.

● You don't have to watch it—lead screw can't jam on workholder. New jam-proof drive plate automatically kicks out driving ratchet pawl when standard length thread is cut. Your recent model 65R easily converted—just buy new drive plate, put in place of old plate. Perfect threads on 1″ to 2″ pipe with one set of 4 high-speed steel dies—sets to pipe size in 10 seconds, mistake-proof self-centering workholder sets instantly! Buy the new jam-proof RIDGID 65R at your Supply House.

RIDGID

★ Work-Saver Pipe Tools ★

THE RIDGE TOOL CO. • ELYRIA, OHIO

WORLD OIL'S Trading Post

CLASSIFIED ADS

SERVICES · PERSONNEL · USED EQUIPMENT

RATES: Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

FOR SALE

■ Well drills, spudders, rotaries, core-drills. All sizes new and used equipment. Tools, drill pipe, cable, pipe. Fishing tools rented. Everything for well drilling. Pressey & Son, Pueblo, Colorado.

FOR SALE

12,500′ rig with Titan-Wilson drawworks; powered with three 350 HP Leroy motors. 2 18″ Oil-well mud pumps. 12″ QRC blow-out preventer. 400 ton traveling equipment and swivel. Vibrator shale shaker. 136′ heavy duty derrick. Steel mud house; 2 steel mud tanks. 7½ KW light plant. 10,300′ of 4½ Reed extra hole super-shrunk drill pipe which has drilled less than 30,000′; 6 6⅛ drill collars. Above equipment is modern and in first class condition. Contact Vernon Whiteley, Fair Foundation Building, Tyler, Texas; phone 2-2212.

NEW DEVICE

Thoroughly Proven. Over 200 in use. Used in production, pipe line, refinery and chemical plants. Outright sale or royalty. Box 13-W, c/o World Oil, Houston, Texas.

FOR SALE

Wyoming Oil Properties, Production, Leases, Royalties. Owner Box 1004, Casper, Wyoming.

WANTED TO BUY

■ WE WILL BUY Producing Oil Royalties. Send Particulars. Standard Security Co., 115 Broadway, New York 6, New York.

■ INDIVIDUAL will purchase producing royalties, oil or gas. James R. Curtis, Longview, Texas.

SITUATION WANTED

Drilling contractor operating in West Texas and New Mexico desires to contact small or medium-sized independent oil company who needs an operating manager. Personal interview desired. Twenty years experience in all phases of the oil industry. Address replies to Box 94-W, WORLD OIL, Houston 1, Texas.

■ Young purchasing agent ten years experience drilling and production equipment major oil company desires position in purchasing or allied field where ability, ambition, etc. will build future. Box 11-W, World Oil, Houston, Texas.

FOR SALE

FOR SALE
In Good Condition

COMPLETE ELECTRIC GENERATING PLANT, dual units, 200 kw capacity. Engines, generators, switchboards and instruments. Used in oil field service Sothern Illinois.

ALSO

NATIONAL-TRANSIT STEAM DRIVEN CRANK AND FLYWHEEL PUMP, nigh and low pressure side, size 24 and 48 x 4½ x 24, 20,000 gal./hr. capacity. Used in refinery hot oil service Northwestern Ohio. Write Box 14-W, WORLD OIL, Houston, Texas.

HELP WANTED

WANTED IMMEDIATELY ENGINEER experienced in natural gas utility field by one of fastest growing natural gas companies in Southwest. Must have following qualifications. More than 30 years of age. Prefer person with college degree in engineering: petroleum, civil or mechanical. At least three years of college and five years of experience with natural gas or natural gasoline company, including the following phases—drafting, compressor station design and operation, hydrogen sulphide removal plants, gas well testing, gas measurement, drilling operations. Salary commensurate with experience. Pleasant working conditions, numerous attractive employee benefits after period of regular employment. Location in Dallas, Texas. Submit abstract of experience, qualifications, employment history to Box 10-W, c/o World Oil, Houston, Texas.

INVESTMENT OPPORTUNITY

SPOT CASH PAID FOR PRODUCING ROYALTY

Small to largest blocks in settled or old production only.
Oil Specialists Since 1934.
GERBER & CO.
120 Wall Street, New York, N. Y.

■ TRADE: Casing and tubing for ground floor interest in proven or semi-proven production. Principals only, send full details to Box 8W, WORLD OIL, Houston 6, Texas.

■ Well established British Oil Equipment and Supply Company with Head Office in London is interested in acting as European and Sterling Area sales representatives for all classes of equipment and supplies connected with the Oil and Mining Industries. Please communicate with Box 12-W, World Oil, Houston, Texas.

Use the Trading Post For Sale, Services

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Stewart & Stevenson Firm Installs Low Temperature Testing Chamber

The South's largest commercially owned test chamber for testing starting and operating characteristics of diesel and gasoline engines at temperatures as low as —80° F. has been installed in the Houston plant of Stewart & Stevenson Services.

One of the contributing factors in the installation of the new cold test chamber, it was said, is the increasing demand of government requirements for diesel and gas driven generator sets for starting and operating at these low temperatures. At present Stewart & Stevenson Services is producing diesel generator sets to operate under these extreme conditions.

Byron Jackson Company Promotes Kirby to West Texas Area Manager

Byron Jackson Company Oil Tool division has promoted John Kirby to district manager for West Texas, with headquarters in Odessa, Texas.

Kirby was formerly with Halliburton Oil Well Cementing Company for four years, and had also worked four years with Security Engineering Company before joining Byron Jackson as sales representative in 1947.

John Kirby

Keelan Will Continue to Handle Soll Products for Diamond Drilling

Ed Keelan, former sales manager for Soll Core Barrel Company, has joined Diamond Drilling Company, Long Beach, which has taken over exclusive distributorship on the Soll Telescoping Core Barrel and the standard Soll Core Bits and Barrels. Keelan will continue to serve his present customers in the Los Angeles Basin. He was formerly a member of Standard Oil Company of California's drilling department for many years, prior to his connection with Soll.

Iverson Division Managers Meet

S. J. Iverson, president, presided over the division managers' meeting at Iverson Supply Company's general offices in Tulsa. Others who attended are A. M. Iverson, executive vice president; Ed Robertson, vice president, sales; H. B. Downing, secretary-treasurer; and H. D. Lawver, purchasing agent. Out-of-town division managers included E. E. Zeigler, Artesia, N. M.; Henry F. Oliver, Midland, Texas; R. B. Yanaway, Houston; and Wayne Wallace, Oklahoma City.

Ideco Opens Office in Midland

International Derrick & Equipment Company has opened a new sales office in Midland, Texas, on the ground floor of the Petroleum Building. George W. H. Rush, city sales representative, is in charge of the new Ideco Supply Stores division office.

New Books, Maps and Movies

Offshore Lease Blocks

All Texas and Louisiana offshore lease blocks, from Brownsville to the Delta, are shown on a new map, "Langburn Map of Offshore Lease Blocks in the Gulf of Mexico." In addition to listing the blocks by number, the map also indicates offshore discoveries, water depths, sedimentation lines and other pertinent information. Included also are some of the findings of a statistical analysis indicating the probability of tropical storms affecting various offshore areas during the hurricane season, June 1 through October 31.

Langham, Langston & Burnett, 3700 Montrose Boulevard, Houston 6. $2.50.

Marine Geology

"Marine Geology" is the title of a new book by Dr. P. H. Kuenen, director of the Foundation for Marine Geology at Groningen, Holland, and professor and head of the Geological department at the University of Groningen.

A summary of the present knowledge and controversial problems regarding the geology fo the seas, this book discusses submarine landforms and their interpretation, the structure of atolls, the processes of sedimentation and many other subjects. Because of his experience as geologist for the Snellius Deep-Sea Expedition in the Moluccas, the author pays special attention to coral reefs, submarine canyons and the Moluccan deep-sea troughs.

John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16.

1950 Discoveries

"Discoveries of 1950" is a large volume of comprehensive statistics and maps reviewing new oil development in Texas, New Mexico and Coastal Louisiana. Compiled by Frank J. Gardner of *Five Star Oil Report*, the information is sectionalized by areas, and broken down within the sections to data on new fields, new pools, and extensions. Most of the information has been gathered directly from official state sources: the Railroad Commission in Texas, the Louisiana Department of Conservation, and the New Mexico Bureau of Mines and Mineral Resources.

Within each geographical division, overall statistics are presented in tabular form, and followed by details on each field. Each field is mapped, and, for orientation, spotted on a larger may of the general section.

Field data is preceded by a section on U. S. production, as well as generalized statistics on the area considered in the book.

Petroleum News Corporation, Box 331, Houston. Price to subscribers to *Five Star Oil Report*, $10; to non-subscribers, $15.

Yearbook

"Ira Rinehart's 1951 Yearbook" is a breakdown, statistically, of the news reports gathered by Rinehart's staff during 1950. All oil producing states are covered in the two volumes of the 1951 edition, with data on each covering a review of oil developments in the state, summary of drilling activity by counties, and record of producers by years. Field maps on rapidly developing areas are included.

Introductory material includes stock quotations and dividends on oil stocks in 1950 and 1949. Further information includes drilling and production tables for the various states, and details on important wildcat failures in states which added no discoveries during the year.

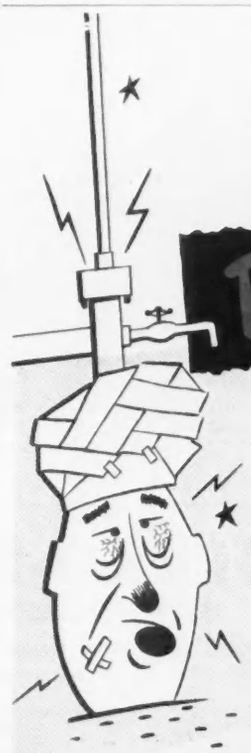
Rinehart Oil News Company, P. O. Box 1208, Dallas. Price to subscribers, $10; non-subscribers, $15.

Permian Basin Map

The 1951 Edition of the "Executive Map of the Permian Basin," printed in three colors, contains production data on all fields in the area. Drawn to the scale of 1 inch equals 5 miles, the lithographed reference map is 3 x 4 feet.

The blue base shows sections, surveys, towns, oil wells, drilling wells, and dry holes, with operator and farm name and total depth on wildcats. Red shows field names, producing formation, depth, year of discovery, and number of producing wells. Lease block outlines and year of expiration are in green.

Southwest Mapping Company, 1116 Continental Life Building, Fort Worth 2, Texas. Complete, $10; without green overprint, $7.50; without green or red overprint, $5.

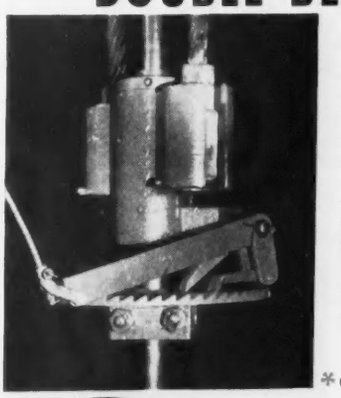


A SURE CURE for PARAFFINITIS*

There is no need to put up with this malady . . . no need to give your wells frequent and costly treatments of steaming out or pulling the rods to remove paraffin and maintain production.

Huber Paraffin Scrapers are a permanent cure for paraffin accumulation. Attached to the sucker rods, they wipe the tubing walls clean of paraffin. The scraper blades are shrink-fitted to the rods which are rotated by the Huber Rotating Rod Hanger. Wiping action takes place as the string is rotated and reciprocated.

DOUBLE BENEFIT ROTATION



The combined rotating and reciprocating motion wipes paraffin from the tubing in particles so small they go out in solution . . . can not clog tubing, scrapers, or flow lines. Rod rotation prolongs coupling life by equally distributing wear . . . prolongs pump life and efficiency by equalizing wear on working barrel. Get this added benefit while eliminating paraffin accumulation by installing Huber Scrapers and Huber Rotating Rod Hangers.

Cure your wells of paraffin accumulation . . . install Huber Paraffin Scrapers and Rotating Rod Hanger, NOW!

* Congestion caused by the accumulation of paraffin in pumping wells.

For further information see your local supply store, or write

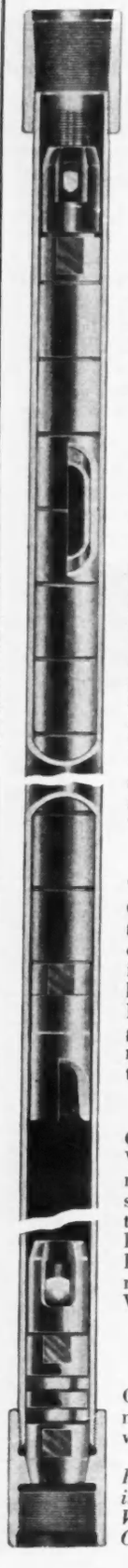
HUBER

J. M. HUBER CORPORATION,
Box 831 . . . . . Borger, Texas

PARAFFIN SCRAPERS

SCRAPE AS THEY ROTATE AS THEY RECIPROCATE

Reduce Your Oil Lifting Costs



USE O'BANNON ARROW TUBING PUMPS

In Your Large Volume Wells

●

LOW FIRST COST

First cost of the Arrow Tubing Pump is low because of its simple construction. Barrel is a one-piece precision tube and connections are simpler than those on other types of tubing pumps.

LOW REPAIR COST

Repair cost is low because of simple construction, wear resistant qualities of materials and matching of barrel and plunger materials to make barrel last longest. Most repair jobs do not require tubing to be pulled—only rods. Plunger consists of grooved alloy metal sections mounted on a precision ground seamless tube. When plungers are repaired, only the worn sections are ordinarily replaced—threaded parts are used over and over again, not scrapped as necessary with worn out one-piece plungers.

TWO TYPES

TOP AND BOTTOM COLLAR TYPE (Illustrated) for average wells—especially where high gravity, gassy fluids must be handled. TOP COLLAR BOTH ENDS TYPE where gyp and sand conditions make a "stroke-through" type of pump desirable.

TWO GRADES

CRO-LAY BARREL AND WEARLOY PLUNGER for maximum resistance to abrasion and for minimum friction. PLAIN BARREL AND HARDENED IRON PLUNGER where abrasion resistance of Cro-Lay and Wearloy is not required.

TWO CLASSES OF MATERIAL

CARBON STEEL for ordinary wells. CORRESIST where Corrosion is severe.

Run O'Bannon Arrow Tubing Pumps in Your Large Volume Wells and See Your Costs Go Down.

Buy Them at Your Supply Store

Walter O'Bannon Co.

Tulsa 1, Oklahoma

Straight from the Horse's Mouth

Elder Johnson of Squinberry Gulch predicts that the next general election slogan of the Democratic Party will be, "Don't change horses, or any part thereof, in the middle of the stream."

Proof

She: I think men should wear something to show they're married. Women wear wedding rings.

He: Men wear something to show they're married. They wear last year's clothes.

Man's World?

Until the time comes when a man can get alimony by crossing his legs and showing his garters to the jury, equal rights are only a snare and delusion, according to one male observation.

Fuller Explanation

The minister called at the Jones' home one Sunday afternoon, and little Frankie answered the bell.

"Pa ain't home," he announced. "He went over to the golf club."

The minister's brow darkened, and Willie hastened to explain:

"Oh, he ain't gonna play any golf. Not on Sunday. He just went over for a few highballs and a little stud poker."

To Each His Own

The jury foreman reported that it appeared impossible to reach a verdict.

"If you do not reach a decision before evening, I'll have twelve suppers sent up to the jury room," said the judge.

"May it please your honor," spoke up the jury foreman, "make it eleven suppers and one bale of hay."

How Things Are Done

"My dear, I never imagined you would marry the man you did," said one young matron to another.

"Neither did I," replied her friend. "I disliked his ways, but I adored his means."

Just Another Day

The tourist came upon a farmer in the back country holding a hog up to an apple tree while the animal munched on apples.

"Isn't that a rather slow way to feed him?" the tourist asked.

"Could be," reckoned the farmer. "But whut's time to a dern old hawg?"

FLEXO-SCREENS

PROVIDE EXCELLENT IDENTIFICATION

You are always sure of the finest equipment identification with a genuine FLEXO-SCREEN. And so easy to apply too . . . no experience or skill necessary.

DRILLING
HANCOCK DRILLING CO.
HOUSTON, TEXAS
WELL SERVICING

FITS DOOR CURVES AND FLAT SURFACES WITH EQUAL PERFECTION

Hundreds of applications of fine, yet durable lettering in raised enamel that defies the elements. WILL NOT CRACK, CHIP, PEEL, or FADE.

If you are economy-minded, yet like the finest in identification lettering, then you will appreciate the merits of FLEXO-SCREEN.

YOUNGER BROS. J.M. ENGLISH TRUCK LINES INC.

"Since 1944, have been using your screen plates for lettering our motor trucks with very satisfactory results . . ."

OIL FIELD & HEAVY HAULING
B.F. COBB TRUCK LINE
HOUSTON, TEXAS
PIPE STRINGING

". . . Have tried other methods, we much prefer your FLEXO-SCREENS since trying them. They sure work nice."

COLBURN BROS.
TRUCKS-TRACTORS
DRAGLINES
HOUSTON TEXAS

". . . I want to express my complete satisfaction to FLEXO-SCREENS . . . they've done us an excellent job . . ."

Write for full details

Equipment Identification Co.

514-15 Peoples Bank Bldg.
Indianapolis, Indiana

McCullough Services

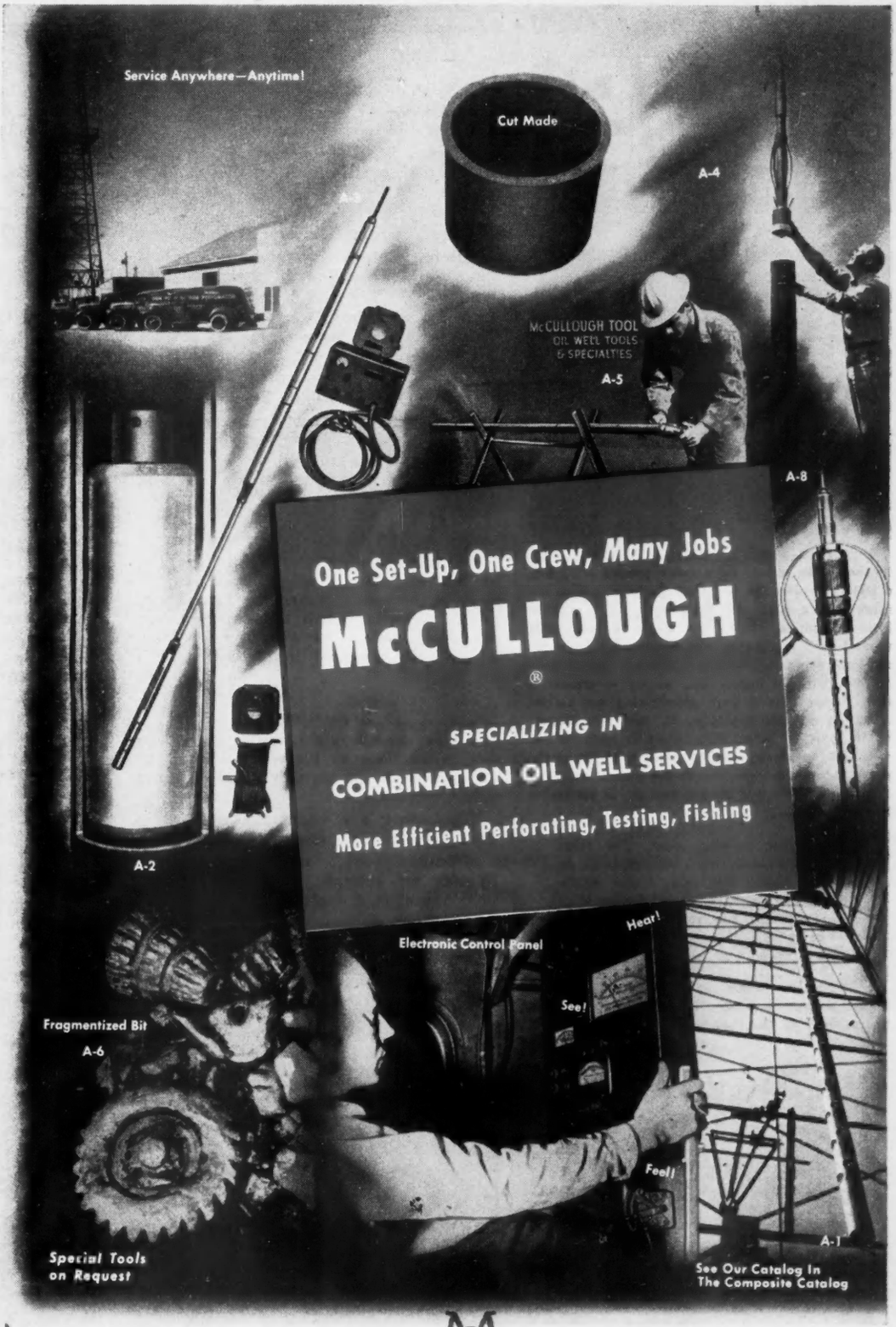
A ELECTRIC WIRE LINE SERVICES

1. PERFORATING—Deepest penetrating burrless bullet and jet.
2. BRIDGING PLUGS—Drillable, expandable. McCullough and Baker.
3. MAGNA-TECTOR*—Locates stuck point of pipe, accurately, fast!
4. JET CASING CUTTERS*—World's fastest casing, tubing, drill pipe cutter!
5. JET BACK-OFF TOOL* and STRING SHOT—World's fastest way to recover stuck pipe!
6. JET BOTTOM HOLE CUTTERS*—Fragmentizes lost or stuck fish!
7. ELECTRONIC WEIGHT INDICATOR*—Supersensitive, small, light!
8. SONIC DEVICE*—Locates collars, liner tops, well bottom, etc.

E ROTARY SERVICES

1. DOUBLE ACTING ROTARY JARS* and BUMPER SUBS—Reduces number of fishing jobs!
2. SAFETY JOINTS—Releases quickly in emergencies!
3. EXTERNAL DRILL PIPE CUTTERS—For all outside pipe cutting.
4. MECHANICAL LONG KNIFE INTERNAL CASING CUTTERS—All sizes pipe, tubing.
5. THIN WALL EXTERNAL CASING CUTTERS*—For outside cutting in small clearances!
6. ROTARY RELEASING OVERSHOTS—Completely encircles fish.
7. ROTARY RELEASING SPEARS—Engages or disengages at will.
8. GUN TESTER—Water shut-off, perforating, testing in one run.

*Exclusive McCullough Services



Ask your McCullough service man about *time-saving COMBINATIONS of these services*

McCULLOUGH TOOL COMPANY

5820 South Alameda Street, Los Angeles 58, Calif. • 405 McCarty Street, (P.O. Box 2575) Houston, Texas

Export Office: Los Angeles, California

TEXAS: Snyder, Alice, Houston, Cisco, Corpus Christi, McAllen, Odessa, San Angelo, Tyler, Victoria, Wichita Falls. **OKLAHOMA:** Oklahoma City, Guyman, Healdton. **MISSISSIPPI:** Laurel. **NEW MEXICO:** Hobbs. **KANSAS:** Great Bend. **CALIFORNIA:** Los Angeles, Avenal, Bakersfield, Ventura. **LOUISIANA:** Houma, Lake Charles, New Iberia, Shreveport. **WYOMING:** Casper. **CANADA:** Edmonton. **VENEZUELA**—United Oilwell Service Co., S.A.: Caracas, Anaco, Maracaibo.

Mid-Continent NEWS and HUMOR?

Humor is like a ride on a roller coaster . . . like a home run over the left field fence . . . like the sparkle in a glass of champagne . . . it's the little something extra that makes a day seem worthwhile . . . In the Mid-Continent NEWS, the company magazine for the employees and friends of Mid-Continent Supply Co., we try to present a little humor that is both entertaining and zestful . . . yet not objectionable. We feel that humor, at its best, is what YOU make it, and in our selections we operate on the same principle as the young ladies above—we see no evil—speak no evil—hear no evil. Here is a sample from one of our recent humor sections—

> It was their wedding night. The bride murmured dreamily from the depths of an oversized bed: "Darling, I can hardly believe we're actually married." In a voice choked with rage and frustration, the groom answered: "If I can ever get this damned shoelace untied you will!"

. . . And for lovers of fine art, the NEWS always presents a little "Tease-Cake" to enhance the columns of the publications.

MID-CONTINENT
Supply Company
General Offices Mid-Continent Bldg. FORT WORTH, TEXAS

SQUEAKS FROM THE BULLWHEEL

Sure Cure

Jake: Your wife used to be so nervous. Now she doesn't seem to show a sign of it. What did you do for her?

George: That was easy. The doctor simply told her nervousness was a sign of age.

Same Old Story

"Do fairy tales always begin with, 'Once upon a time?'" asked the little daughter of the house.

"No indeed, dear," replied her mother. "Sometimes they begin with, 'My love, I will be detained at the office tonight!'"

On the Right Track

"I've simply got to win this race," said one race horse to the other. "My owner told me if I win there'll be 30 bales of hay for me . . . and that ain't money, son!"

A Family Affair

A shy lad wanted to marry the girl, but he felt he would choke if he tried to mention the words, "marry" or "marriage" to her. So after much thought he asked her one evening, in a whisper, "Julia, how would you like to be buried with my people?"

Reparations

Father, who was a traveling man, was met at the door by his young son on returning from a periodical trip sooner than expected.

"Dad, there's a bogeyman upstairs in mama's room," announced the young son.

"Nonsense, son," replied the father. "You're old enough to know there's no such thing as a bogeyman."

"You just go look for yourself," challenged the son.

So Dad went upstairs and anxiously opened the closet door. And, sure enough, there was his good friend Sam, from the old country.

"Why, Sam!" he exclaimed. "How could you do this to me? Didn't I rescue you from the clutches of the Nazis and bring you over here from Europe and get a fine job! And now you repay me by hiding in the closet and scaring my little boy!"

A Hard Question on Easy Payments

Why is it that people spend money they don't have to buy things they don't need, to impress people they don't like, for reasons they don't understand?

The New Order

In New York's Union Square, the rumpled, wild-eyed young man was declaring to a small crowd assembled the glories they would have, "comes the revolution."

"In the New State," he shouted "each man of you will be walking down Park Avenue in a top hat, a cutaway coat, and striped trousers, and you'll have a carnation blossoming from your lapel."

A small, quiet fellow on the edge of the crowd spoke up. "If you don't mind, I'd just as soon wear my cloth cap."

The orator smiled indulgently at the poor fellow, and said, "Well, in the New State you'll be wearing a cutaway and striped trousers, anyway."

"My old corduroys will do just fine," protested the little fellow.

The agitator was then completely annoyed, and, striding down from his soap box, he seized his critic by the shoulder and cried, "See here, now, understand this! In the New State you'll damn well do what you're told!"

Year after year

CONSISTENTLY
the best weight material

500 DISTRIBUTION POINTS PUT BAROID WHERE YOU WANT IT WHEN YOU WANT IT

AND THERE ARE GOOD REASONS WHY!

Ever since 1925, when Baroid was first introduced, operators and drillers have found Baroid uniformly, *consistently*, tops in quality. The pure ground barytes in *every* sack in *every* batch meets the same high standards of fine grind, high specific gravity and freedom from impurities. Baroid consistently provides maximum weight with minimum viscosity.

HOW? BECAUSE...

Baroid Sales Division owns and operates the most extensive deposits of high-grade barytes, and the milling processes are supervised by trained metallurgists whose assignment is to make *every* sack of Baroid meet the highest standards of quality.

Baroid
BAROID SALES DIVISION
NATIONAL LEAD CO.
Los Angeles 12 . Tulsa 3 . Houston 2

COMPLETE DRILLING MUD SERVICE

For Superior
PERFORMANCE
Insist on

HINDERLITER STRIPPER RUBBERS

For smoother performance, longer wear, greater economy, buy Hinderliter Stripper Rubbers for your 4 in 1 tubing heads. There's no worry that these stripper rubbers will fail causing loss of sealing medium in annulus of head. Hinderliter Stripper Rubbers are the only ones bonded at both *top and bottom* with sturdy steel rings . . . the rubbers absolutely cannot fall down the well. They're made of long lasting, top-quality HYCAR Synthetic Rubber which is impregnated with a special lubricant to reduce possibilities of a bonding action between stripper rubbers and tubing.

HINDERLITER PORTER "Better Built" EQUIPMENT

Insist on Hinderliter Stripper Rubbers on all your wells.

HINDERLITER
TOOL COMPANY DIVISION
H. K. PORTER COMPANY, INC.
Tulsa 1, Oklahoma

SQUEAKS FROM THE BULLWHEEL

Source of Income

A minor-league baseball club had sold one of its prize rookies to a major-league team for a fancy price, and the rookie moved his small family to the big city. The first day in town his wife and little daughter went window shopping. The little girl spied a gorgeous doll that cost $25.

"Oh, Mother," she cried, "I wish I could have that!"

"But dear, it costs too much—we can't afford it."

"Why not?" she asked. "Couldn't we sell Daddy again?"

Mink's Hi-Jinks

When the little mink died and went to Heaven, St. Peter told him, "We haven't had any minks up here before, so we don't know exactly what to do for you. However, you were a good little mink on earth and we want you to be happy, so we will give you anything you want."

"Please, St. Peter," pleaded the little mink, "could I have a coat made out of chorus girls?"

First Aid

The doctor rushed out of his study. "Get my kit at once!" he shouted.

"Why, Dad," asked the daughter, "what's the matter?"

"Some fellow just phoned he can't live five minutes without me," gasped the doctor, reaching for his hat.

His daughter breathed a sigh of relief. "Just a moment," she said quietly, "I think that call was for me."

"Before you get started, Yes, I'm the farmer's daughter, and yes, I always wear these shorts when I work . . . and I also have a degree in geology and a lease on our farm will cost you $50 an acre more than you paid the folks down the road!"

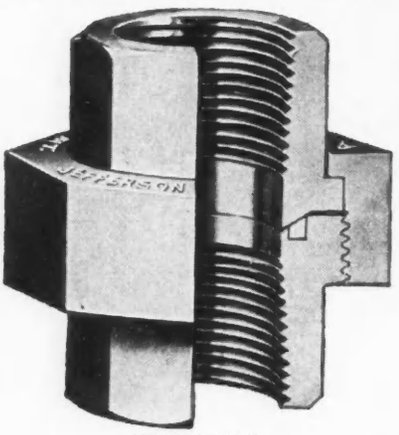
Can't Complain

It was one of the darkest hours of the depression years, and Sam was standing despondently in front of his jewelry store when a friend walked by.

"How's business, Sam?" queried the friend.

"Just fine, just fine," replied Sam, adding, "if I had any."

Jefferson Malleable Unions



STYLE "A"

JEFFERSON Style "A" Unions and Style "A" Union Fittings can be furnished with Brass-to-Iron, and Iron-to-Iron Seats.

HYDRAULIC PRESSURE RATING

Sizes	*Test Pres.*	*OWG*	*SWP*
⅛" thru 2"	4000#	1500#	500#
2½"	3000#	1200#	300#
3" and 4"	2000#	800#	300#

Our "Iron-to-Iron seat" unions are highly recommended and especially desirable where sulphur content of oil is high; also for chemical services where acid-bearing liquids or gases require the use of iron fittings. AIR FURNACE IRON, having a much denser and finer grain structure, gives a dependable and positive seating surface—ASTM-4733-Grade 35018-53000-lb. M.T.

Obtainable through your jobber

Jefferson Union Company, Inc.

691 West 26th St.,
New York 1, New York

71 Gooding St., Lockport, New York
31 Fletcher Ave., Lexington 73, Mass.